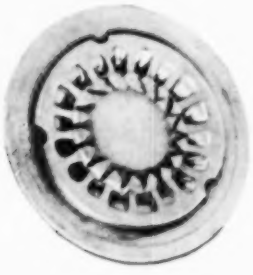
SEPTEMBER 1955

plating

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY



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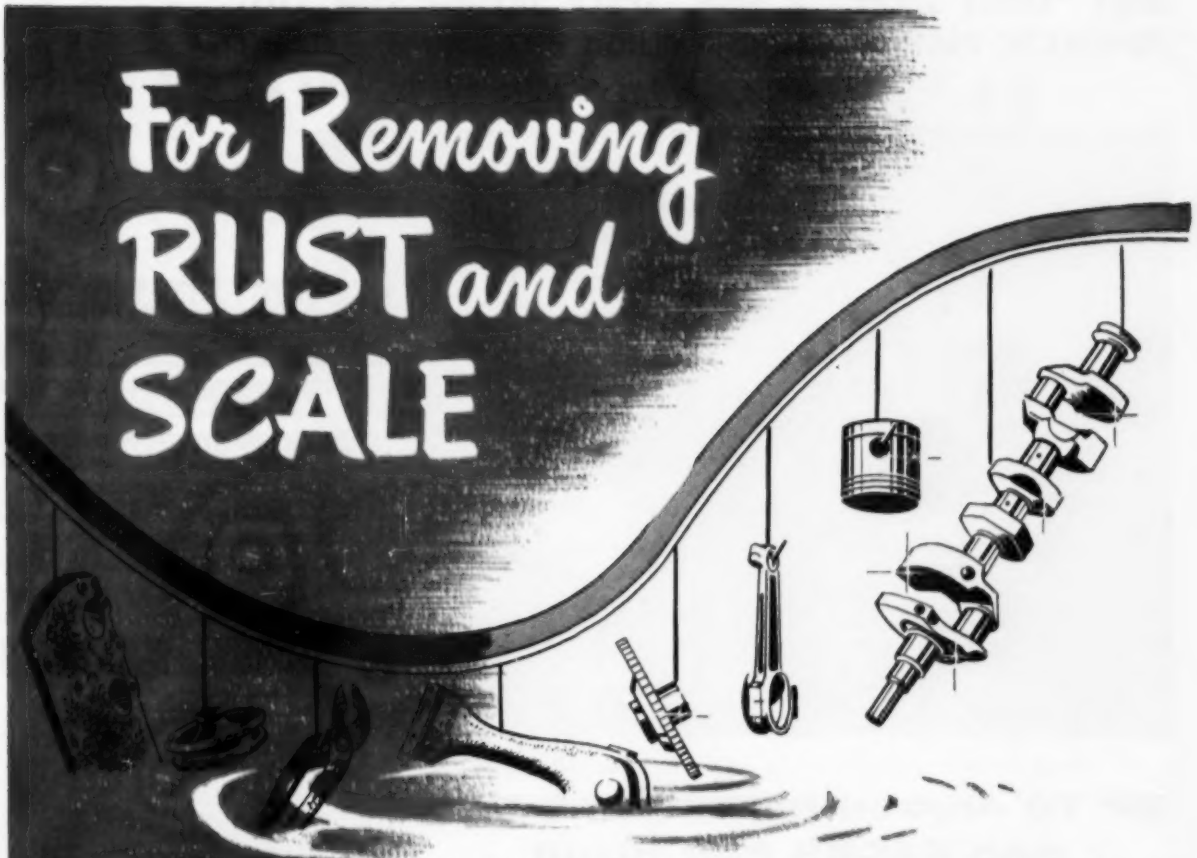

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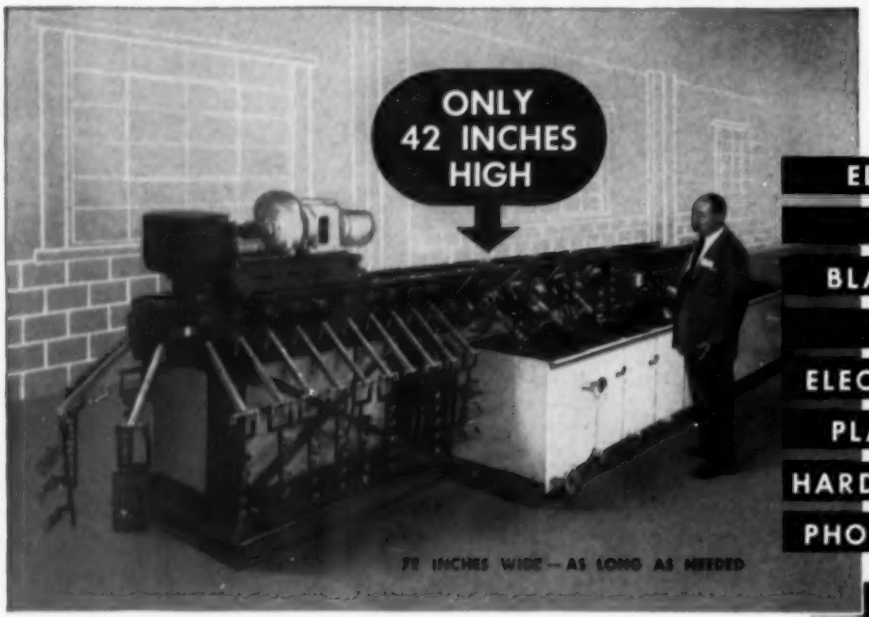

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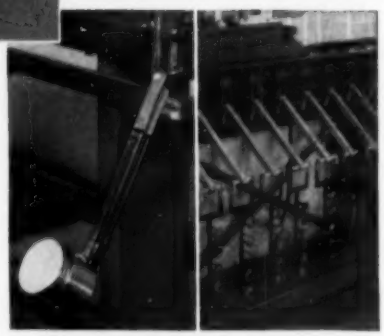
For further information about "LITTLE STEVE" write for illustrated folder or call your local Stevens sales engineer.



A single part can be placed on each carrier arm as shown in the illustration above or racks of numerous parts can be used.

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plating

Journal of the American Electroplaters' Society

September 1955 **Vol. 42, No. 9**

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Western Advertising Representatives

Published by the American Electroplaters' Society, Incorporated, 445 Broad Street, Newark 2, N. J. Phone: HUmboldt 2-3400. Yearly subscription for Members $2.00. Nonmembers U. S. and Canada $5.00, 65c a copy. Foreign, $8.00 a year, $1.00 a copy.

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PLATING is abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, and Bulletin Analytique.

Statements of fact and of opinion given in articles and papers in PLATING are those of the contributors. The American Electroplaters' Society assumes no responsibility for them.

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Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916

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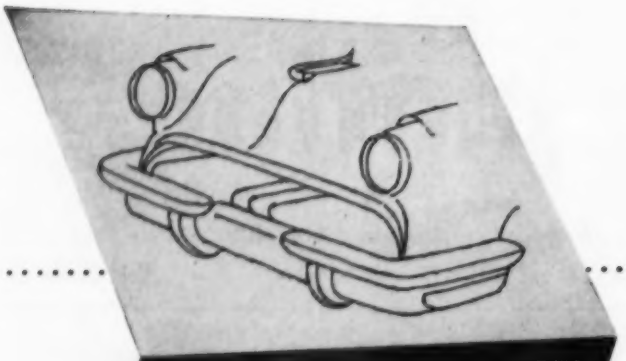

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Editorial

SPECIFICATIONS, THE AES AND YOU

As a producer or buyer of plated or coated products, you are vitally concerned with specifications. They guarantee a product of uniform quality for the consumer and place the producers on an equally competitive basis.

Specifications have arrived at their present status through a long period of evolution. However, revisions and improvements in specifications are ever being made to meet the requirements of new industrial developments, to utilize newly discovered test methods, to evaluate new plating and finishing processes and products and to evaluate more precisely the basic factors which affect the quality of coatings and finishes.

The development of specifications requires experimental data which take years to accumulate. This work is being done by Government agencies, ASTM, Industry, Consumers, Suppliers and by your AES. Your Society is vitally concerned with this development and improvement in electroplating and metal finishing specifications.

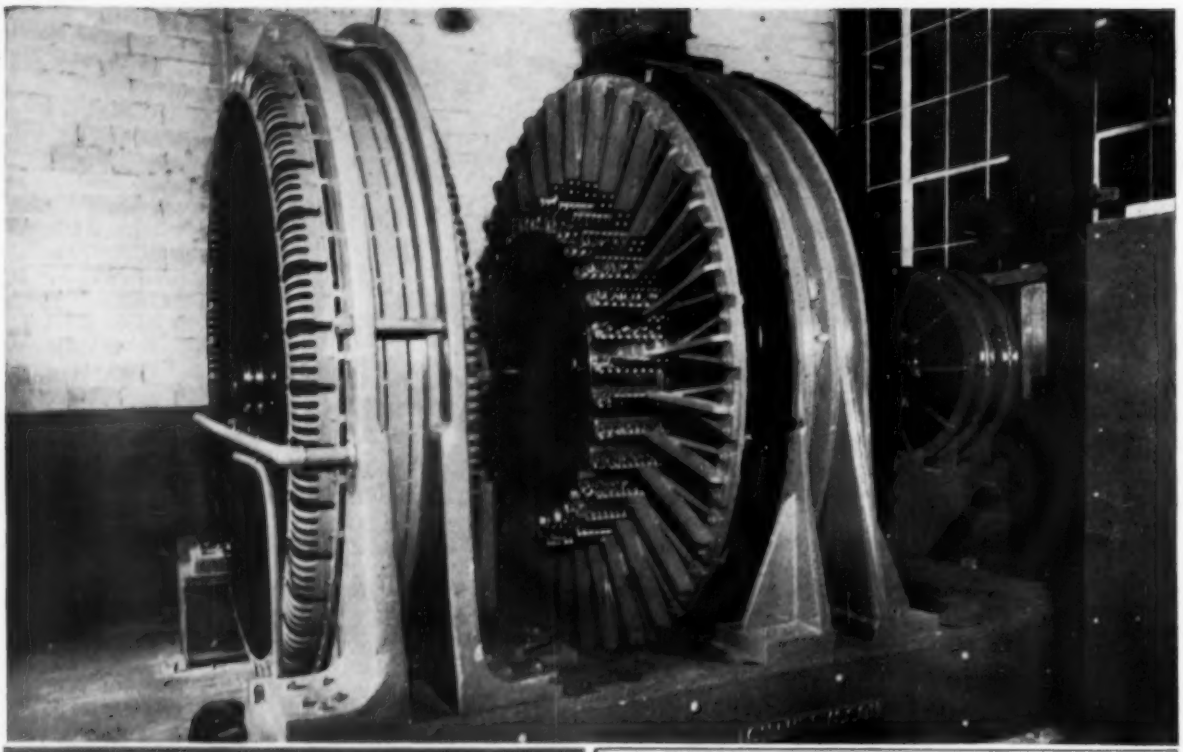
The results of several projects in the AES Research Program are continuously supplying basic information that will have an important bearing on improved specifications for years to come. Included are the following projects:

1. Preparation of a Process Control Handbook.
2. Methods of testing the Adhesion of Electrodeposits.
3. The Effect of Impurities in Electroplating Solutions on Electrodeposits.
4. Methods of Testing the Thickness of Electrodeposits.
5. The Physical Properties of Electrodeposited Metals.
6. The Nature, Cause and Effect of Porosity in Electrodeposits.
7. Study of Accelerated Corrosion Tests for the Performance of Plated Coatings.

This is not the end of AES endeavors in supplying basic specification material—more valuable information will be forthcoming.

Samuel Heiman

1st Vice-President, AES



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For product information write for bulletins D-101 and D-102—for names of users and installation data ask for bulletin D-104.

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TRICKS OF THE TRADE

By Stan Beyer

Stop Squeaking, Squealing, and Surging; Reduce Chain Wear On Conveyor Degreaser

Trichlorethylene crossrod conveyor degreasers are truly "workhorses" in many metal manufacturing plants. They require normal machine maintenance in order to obtain continued satisfactory operation and long life. Yet, in many factories, the conveyor chain runs "dry" because the available lubricants are all removed from the chain on the first pass through the vapor.

Stan Beyer

The trick in obtaining a smooth running conveyor and reduced chain wear is the choice of a proper lubricant, one that will not be removed in trichlor vapors. You can mix glycerine and powdered graphite into a heavy paste of greaselike consistency and apply it occasionally to the chain, or purchase a colloidal suspension of graphite in glycerine ("Glydag," Acheson Colloids Co.) for this purpose.

Be sure too, that your take-ups are aligned. When removing links as the chain wears, be sure the remaining chains are of equal length and don't forget to switch chains to distribute wear.

Lower Temperature and Lower Ratio May be Called for in Hard Chrome Plate

Normally, temperature and chromic acid-sulfate ratio are selected at the center of the bright range for a given current density. For applications of heavy deposits on parts of regular shape, considerable increase in plating speed can be obtained by selecting conditions nearer the boundary of the bright plating range at some sacrifice in throwing power—a factor of small importance—on regularly shaped objects. For example, suppose you are plating 0.020 inch hard chrome at 130° F with 100:1 ratio and 300 asf. With these conditions, the plating time will approximate 21.5 hours. If, however, the temperature is dropped to 120° F with 75:1 ratio, an improvement greater than 10 per cent is obtained as the result of the lower temperature and the ratio change. Thus, over one hour can be cut off the plating time still using the same current density.

Cover Story

Glucinium

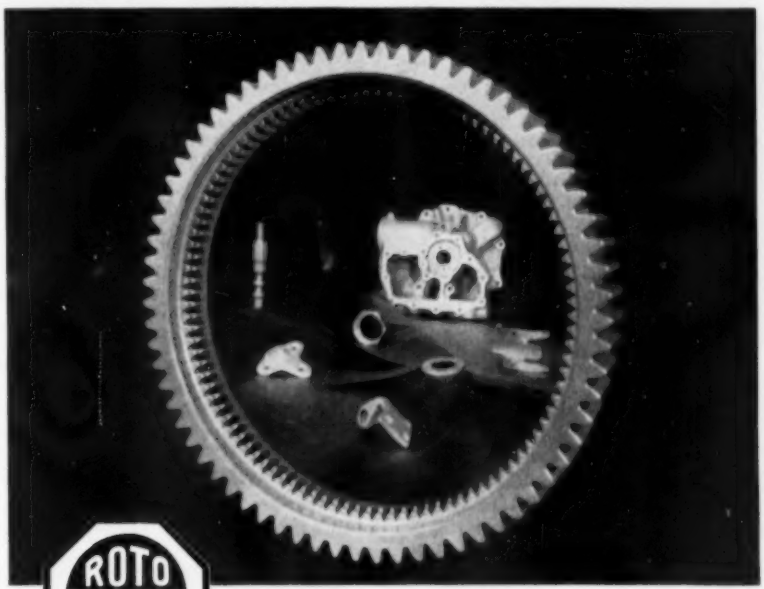
Back in 1798 Vauquelin discovered the oxide of Beryllium which is also called Glucinium. Until recently, little use was made of the metal as such. Of course, it is found in beryl (BeO) which occurs in the New England States, South Dakota, Colorado, South Africa, Madagascar, Austria and France. It makes up about 11 to 13 per cent of beryl.

Beryllium is hard enough to scratch glass and it resembles magnesium in appearance and chemical properties. Its soluble compounds are sweet and there we have the root of its other name, Glucinium, which comes from the Greek word *glykys* meaning sweet. However, its alloys are light, strong, hard and resistant to corrosion. This has led to rather extensive investigations with a view to more common use.

Today, so important is Beryllium that an entire corporation is named after it. Simon Morana, who wrote the article on page 1144 (and who delivered it at the 42nd Annual AES Convention in Cleveland) is employed by the Beryllium Corporation. He used the picture on page 1148 to illustrate some of Beryllium Copper alloy's versatile uses. That picture he used through the courtesy of Manco Products, Inc. We have pirated several sections of that picture and, through the courtesy of the Beryllium Corporation, made a rather startling cover design by following the art concepts developed by Mondrian.

Here, then, we can say that several art and science forms are joined to give us delight, education, information. Beryllium Copper is an alloy which is soft in its completely annealed state; which can be hardened to serve as a mold; which can be plated (*vide* Morana's article).

Beryllium is a sweet metal indeed.



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Industry News

Cowles Chemical Company at Platers' Show. Visitors and attendants in the booth of Cowles Chemical Company took time out for a look at the camera during the recent AES Industrial Finishing Exposition in Cleveland. At extreme left, George R. Woleben, Cowles Technical Man from Brocton, N. Y., demonstrates the adhesive properties of Cowles TY-BOND, zinc phosphate metal coating, to four visitors from Pittsburgh Plate Glass Company, Kokomo, Ind. Standing sixth, seventh and eighth from left are Earl F. Clark, manager; Elmer A. Lord and Carl C. Clabaugh, sales managers of Cowles' Metal Cleaner Department

A New Acid Reclaimer Helps Solve Some Water Pollution Problems. The reclaimer was designed and built by chemists and engineers of Crown Cork and Seal Co.

Company officials predict that widespread use of the reclaiming equipment may eliminate much dumping of industrial waste into city waters. The acid reclaimer removes iron deposits that accumulate in sulfuric acid solutions during a process by which steel is prepared for use in the manufacture of bottle caps. Once the iron deposits have been removed by a method of precipitation, the acid can be used over and over again.

Wyandotte Features Solution of Plating Problems at Exposition. Wyandotte Chemicals' booth at the Industrial Finishing Exposition featured the solving of the problems: Cleaner not free rinsing; Incomplete oil and grease removal; Etching from cleaner; Buffing compound not removed; Poor smut removal; Exhausted cleaner.

Actual plated panels were displayed which illustrated both the defective result and its prevention.

American Wheelabrator Moves District Sales Office. American Wheelabrator & Equipment Corp., Mishawaka, Ind., announces that its district sales office in Detroit, Mich., has been moved to 13504 Fenkell Ave.

G. R. Bryant is district manager for the Detroit office. W. A. Illsley, F. H. Smith and J. W. Swantz are district sales engineers. R. D. Haworth, Jr., and Leo O'Brien are abrasives engineers. D. W. Miller is district service engineer.

New Building Over Railroad Siding for Lining Tank Cars. A new building, 40 feet x 200 feet, has recently been completed over the railroad siding at the Scotts Lane Plant of the MW Protective Coatings Division, Metalweld, Inc., Philadelphia, Pa.

This building was designed to give the most rapid and economical processing possible in the application of specialized coatings to the interior of tank cars for protection of their contents from contamination. Sprayed zinc and aluminum coatings have proved to be most effective for the transportation of water white liquids. Baked phenolic, epoxy, vinyl and rubber coatings provide many specialized surfaces for other products.

The building can accommodate five rail tank cars which can be worked on at one time, independent of the weather, and with all the control and equipment necessary to insure the optimum coating.

Diesel Chemical Co. of Brooklyn, N. Y., has recently moved to larger quarters at 578 Carroll St., Brooklyn, N. Y. The additional space will assure better service and was necessary because of increased business activity in the plating supply field.

More H_2SO_4 in Alabama. G. L. Bond, President of Consolidated Chemical Industries, Inc., announced the award of the contract to build a 500-ton per day capacity contact sulfuric acid plant to Leonard Construction Company of Chicago, Ill. This sulfur burning unit will be built on the Mobile River at Le Moyne, Ala., some 35 miles north of Mobile, on a site adjacent to Courtaulds Inc. Latest engineering features will be included in the design of this unit.

Work on the site is under way and construction is expected to be completed late in the second quarter of 1956.

Shown here are Robert J. Racine, left, Manager Industrial Sales; J. B. Ford, Division of Wyandotte Chemicals, and Stephen O. Johnson, a Cleveland Wyandotte Chemicals Industrial Department Representative, one of several who attended Finishing Exposition

Industry News Briefs

● **Rheem Manufacturing Company,** world's largest producer of steel shipping containers, has entered the reconditioned drum field.

● **Diamond Alkali Company,** Cleveland, Ohio, has announced the formation of **Diamond Chemicals of Puerto Rico, Inc.** The new firm will operate as a subsidiary of Diamond Alkali with *Miles H. Fairbank, Inc.,* of Puerto Rico, holding a minority interest. Substantial increases in sales and earnings of Diamond Alkali Company for the first six months of 1955 over the same period in 1954 were reported today by *John A. Sargent,* president of this leading producer of basic and related industrial chemicals.

● The **Sperry Corporation** has been consolidated with **Remington Rand, Inc.** to form **"Sperry Rand Corporation,"** and as a result Sperry Rand Corporation by law succeeds to all the rights of, and assumes all the obligations of, both The Sperry Corporation and Remington Rand, Inc.

● New applications of ultrasonic cleaners in the fields of atomic energy and commercial aviation, and addition of a new model to its standard product line of the high-frequency units, have been announced by the **Pioneer-Central division of Bendix Aviation Corporation.**

● The executive offices of the **Pennsylvania Salt Manufacturing Company** and headquarters of its operating divisions have been moved from the Widener Building to Philadelphia's newest and most modern office building, Three Penn Center Plaza.

● A revolutionary new type of variable speed a-c motor will be manufactured and made available for the first time in the United States by **Bogue Electric Manufacturing Co.,** Paterson, N. J.

● **Versenes Incorporated of Framingham, Mass.,** purchased by the **Dow Company** in November 1954, and operated since then as a subsidiary, has been absorbed by Dow, *Dr. Leland I. Doan* recently announced. Manufacture of the series of chelating agents sold under the trade names of Versene and Versenol will continue at the Framingham plant but the sales and development functions are being transferred to headquarters in Midland.

● What is believed to be the largest industrial intercity telephone network in the world has been put into operation. **Wheeling Steel Corporation** unveiled its new dial system which interconnects eleven plants on the Ohio and West Virginia sides of the Ohio River.

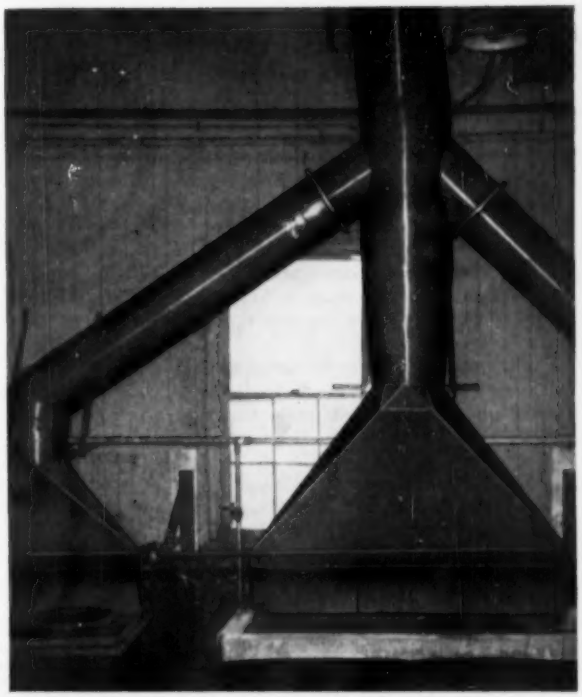
● **American Wheelabrator & Equipment Corp.,** Mishawaka, Ind., has changed its corporate name to **Wheelabrator Corporation,** effective immediately. The move does not involve any alteration in the ownership, management, or operation of the company.

● The formation of an industrial heating division in **Westinghouse Electric Corporation** has been announced by *John K. Hodnette,* vice-president and general manager of industrial products.

● A $1,500,000 contract for high capacity generating systems, has been awarded the **Leece-Neville Company,** Cleveland, by the **United States Ordnance Department.**

● **Foxboro** instrumentation for Asiatic industries will shortly be available through the **Yokogawa Electric Works, Ltd.,** Tokyo, Japan.

● A home study course in Industrial Safety Engineering has been added to the curriculum of **International Correspondence Schools,** Scranton, Pa.



Out of many, one material only has successfully eliminated the problem of replacement at this exhaust duct system over corrosive acid fumes at Sargent & Company, New Haven, Conn. That material is Boltaron 6200. Fabricator: New Eng. Rock Co., Hamden, Conn.

CORROSION IS COSTLY... SAVE MONEY WITH *Boltaron* 6200

Here at Sargent & Company, as in so many similar installations across the country, Boltaron 6200 proves once again that corrosion can be licked, replacement eliminated. Perhaps this remarkable unplasticized polyvinyl chloride can help you. Check its many advantages.

Boltaron 6200 is a rigid material, about one-half the weight of aluminum, which may be machined, formed or welded. It is virtually impervious to corrosive gases and liquids, treated and untreated waters, alcohol, alkalies, strong and weak organic or inorganic acids. It has good impact strength and eliminates replacement problems. It is available in sheet, rod, pipe and block stock.

The limitations of Boltaron are few and deal chiefly with strength and temperature conditions. Trained engineers and fabricators throughout the United States and Canada stand ready to discuss Boltaron 6200 with you in relation to your specific problem. You have much to gain by writing now, Box 128, for further details along with the name of the Boltaron representative in your area.

H. N. HARTWELL & SON, INC.

Industrial Plastics Division, Park Square Bldg., Boston, Massachusetts

NEED EXTRA IMPACT STRENGTH? Ask about Boltaron 7200.

USE READER SERVICE CARD; INDICATE A 906.

Industry News

3M and Udylite Announce. Fluorochemicals have been adopted to reduce acid mist and spray from chromium plating baths, according to a joint announcement of the Udylite Corp., of Detroit, and Minnesota Mining and Manufacturing Co. of St. Paul.

The announcement was made in connection with the dedication in May of the 3M company's new research center near St. Paul.

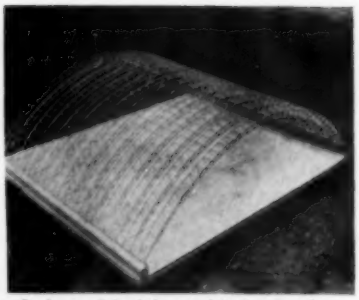
It was pointed out that fluorochemicals constitute the only type of effective compound known to date which is not affected by the highly oxidizing condition encountered in a chrome plating bath.

The 3M fluorochemical is incorporated by the Udylite Corp., in its product, Zero-Mist, described as "an entirely new, completely stable, surface-active additive for decorative chromium plating baths."

The Zero-Mist pellets, when added to the bath, create a yellow foam blanket that lays on the surface of the bath and prevents the escape of chromium mist.

In its literature, the Udylite Corporation said that Zero-Mist cuts chromic acid waste up to 70 per cent, including 50 per cent reduction of dragout losses; that it "completely eliminates chromic acid mist and spray"; that it is "indestructible at all temperatures and in all concentrations"; and that it improves health conditions, eliminates washing of exhausted air, and needs additions only to replace dragout losses.

Northwest Chemical Expands Facilities. Northwest Chemical Company, Detroit, Mich.—nationally prominent manufacturer of chemical cleaners—has completed a new addition to their present facilities according to an announcement by H. J. McCracken, President.



Scale model of the world's largest clear span building, a $17 million prefabricated steel structure 600 feet wide and 1,000 feet long, which will be erected on a near north side site in Chicago, shows unique patented three-hinge triangle truss eliminating internal supports. Framework will be covered by galvanized, corrugated steel sheets

625,000 Amps of Chandeysson Generators Provide Current for Plating at Chevrolet Bumper Plant. The biggest low-voltage d-c generating system in history has been installed and is now in operation at the new Chevrolet Spring and Bumper Plating Plant, Livonia, Mich. The plant, which is reported to be the world's largest, is equipped with a total of 48 custom-built Chandeysson motor-generator sets. They provide a total d-c output of more than 625,000 amperes for round-the-clock operation.

A Chandeysson spokesman stated that the motor-generators range in size from 7,500 ampere units at nine volts to 20,000 ampere units at 12 volts. They were built to require an absolute minimum of maintenance in the almost completely automated plant. An idea of the size of the installation may be gained from the fact that over half a million pounds of copper bus bar were required to connect the generators with their plating tanks.

The plating system consists of three, straight line, fully automatic plating machines, each 535 feet long. Operating at full capacity, they plate a bumper every three seconds.

In April, 1956, Metal & Thermit Corporation will move approximately 200 general office employees to this new building in center the company is erecting at Rahway, N. J. At that time, the firm's executive office will also be moved to 100 Park Ave., New York City

HOW TO BUY RUBBER LINING

FOR LONG LASTING PROTECTION OF EQUIPMENT AND PROCESSES

For pickling and metal plating you need positive protection against corrosive effect of acids on your equipment . . . and the contamination of solutions used in your operations. Linings of thick, non-porous layers of rubber, rather than a mere film or coating, offer the kind of lasting protection that lengthens the service life of your tanks and other process equipment. Rubber tank linings should be compounded to withstand changes in temperature and present a resilient, non-breakable surface at all times.

Look for rubber linings that provide an inseparable bond of rubber to metal. Where linings are bonded to metal so securely they *can't* separate, you are assured permanent protection from corrosion and contamination as well as stray plating currents.

Entrust your equipment to the company with facilities to efficiently handle any equipment lining job, regardless of size or complexity . . . and the reputation of years of leadership in rubber lining technique . . . specify "Manhattan Rubber."

MANHATTAN RUBBER LININGS

Whether your lining problem is simple or complex, Manhattan Rubber Linings assure you lasting protection against deterioration of equipment and contamination of the solutions used in your operations. Manhattan Rubber Linings are made from thick, calendered sheets of natural or synthetic rubber . . . compounded to expand and contract with the metal without cracking and eliminate stray plating currents. Tests prove they cannot be separated from the metal without breaking. To make certain your equipment has perfect bonded protection, every Manhattan Lined Tank is tested under high voltage to detect any possible imperfections. Let an R/M lining engineer show you why Manhattan Rubber Linings are the best you can get . . . contact the R/M rubber lining facilities nearest your plant. RM 524

RUBBER LINING PLANTS AT PASSAIC, N. J.—NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose
Fan Belts • Brake Linings & Blocks • Clutch Facings • Packings • Asbestos Textiles
Engineered Plastic, and Sintered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

"tank life DOUBLED with...

Cowles NS CLEANER!"

reports large Midwestern manufacturer

That's what happened when this major manufacturer put Cowles NS —heavy duty soak cleaner—in its cleaner tanks. Tank life was doubled, quality of cleaning was improved, and total cost was reduced greatly.

Cowles NS eliminates soap scum build-up to assure long tank life and prevent deposition of scum on cleaned parts. High emulsification properties of Cowles NS keep the tank clear and reduce the costly, time-consuming process of dumping, cleaning and recharging tanks—jobs can be run *up to twice as long* without changing.

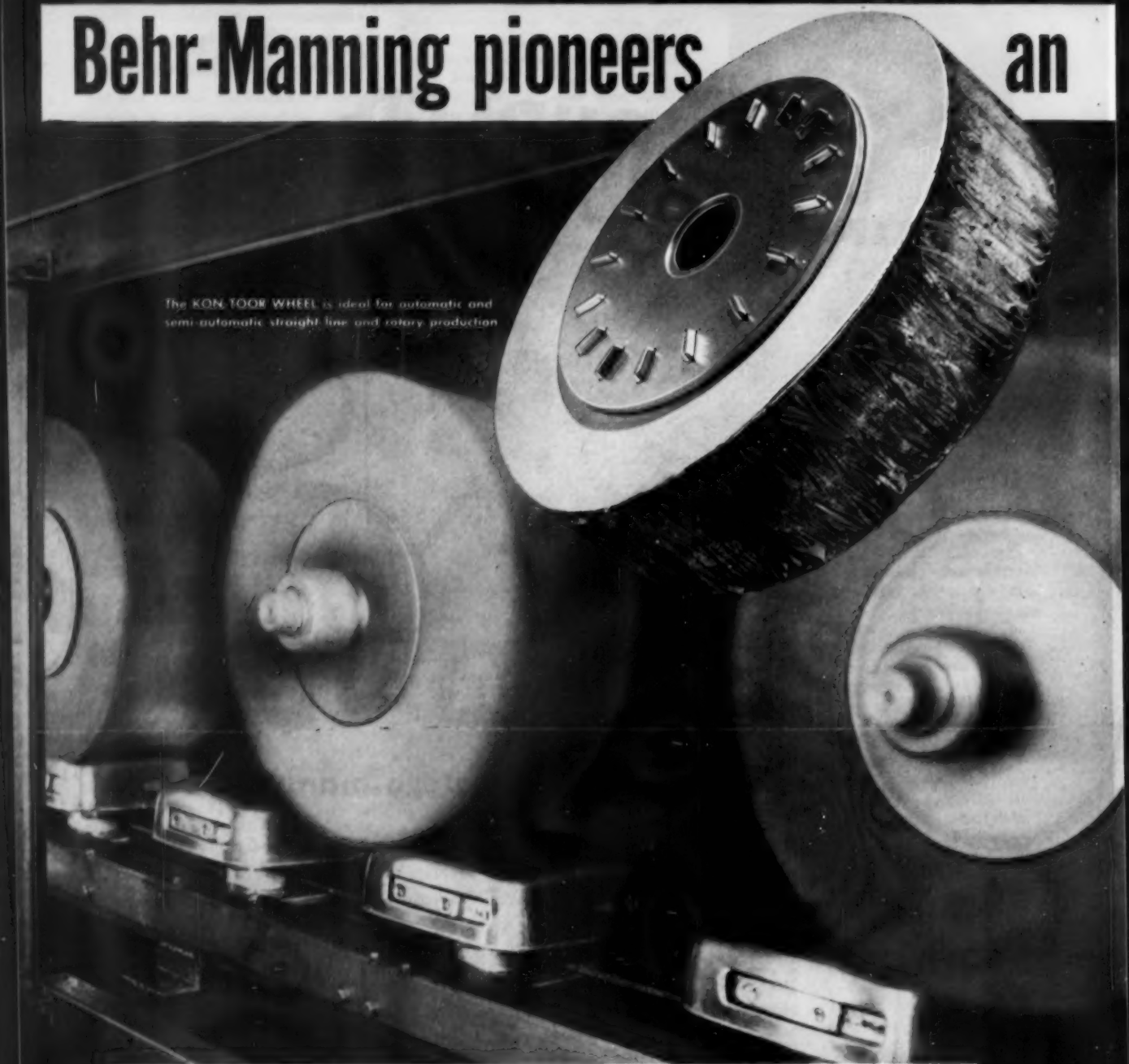
Cowles NS provides outstanding cleaning results and its flexibility permits its successful application in both porcelain enamel plants and in plating plants.

Your Cowles Technical Representative will be very happy to discuss your soak cleaning problems with you and help bring the same exceptional results with Cowles NS that this and many other plants have experienced. Write or call today.

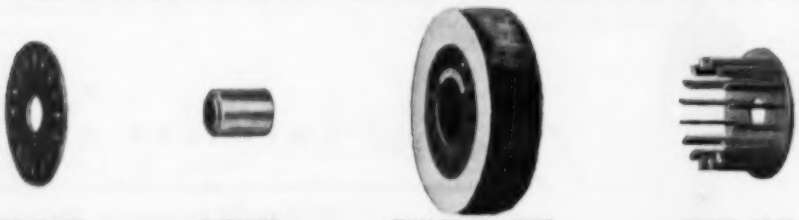
Cowles CHEMICAL COMPANY
METAL CLEANER DEPT.

7016 Euclid Avenue • Cleveland 3, Ohio

Behr-Manning pioneers an



AN EXPLODED VIEW OF WHEEL COMPONENTS...



SIDE PLATE | BUSHING | KON-TOOR WHEEL | WHEEL CAGE

The KON-TOOR WHEEL is constructed of numerous segments of double-faced abrasives and is available in face widths 2" to 7" inclusive – Flexible or stiff construction. Multiple wheels can be used for widths over 7".

For the newest in coated abrasives...watch BEHR-MANNING!

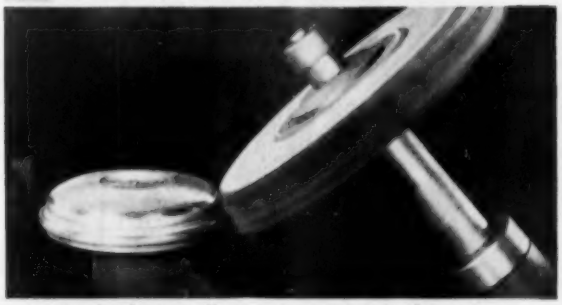
entirely new concept in polishing!

...the ALL coated abrasive KON-TOOR® WHEEL

CAN BE SHAPED TO CONTOUR

Note how the KON-TOOR WHEEL hugs the radius of this stainless steel cooking utensil.

PRODUCES FINER FINISHES



An intricate radius on a pressure cooker cover gets polished by a 2" face KON-TOOR WHEEL.

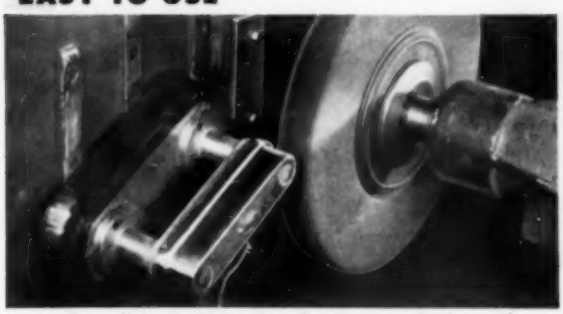
MINIMUM LUBRICATION REQUIRED

It cuts cooler all the way – A 2" face KON-TOOR WHEEL polishing a drawn steel coffee pot.

CUTS FINISHING COSTS

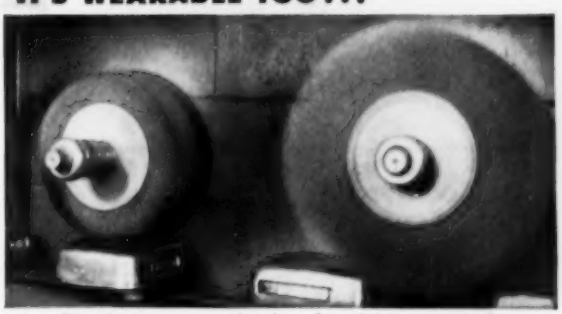
Polishing production soars with the KON-TOOR WHEEL on jobs like this aluminum stamping.

EASY TO USE



Complicated conversion factors are eliminated. The KON-TOOR WHEEL is easily adapted to standard lathes and work-holding fixtures.

IT'S WEARABLE TOO!!!



Stands up to production for days and weeks instead of hours – note wheel at left still producing after days on the job.

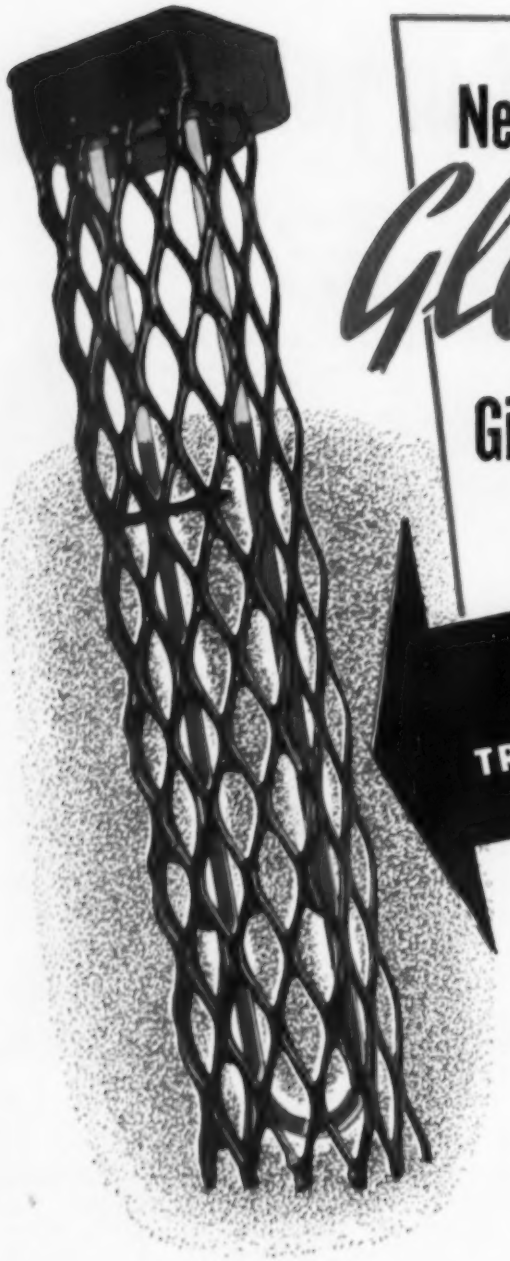
● For details, contact your local Behr-Manning Field Engineer, or write today to Behr-Manning, Troy, N.Y., Dept. PL-9

In Canada: Behr-Manning (Canada) Ltd., Brantford.
For Export: Norton Behr-Manning Overseas Inc., New Rochelle, N.Y., U.S.A.

BEHR-MANNING
division of NORTON Company

▲ COATED ABRASIVES
▲ SHARPENING STONES
▲ PRESSURE-SENSITIVE TAPES

2-8



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Gives Amazing Performance

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TRANSLUCENT FUSED QUARTZ IMMERSION HEATER

Guaranteed for One Year
World's First Successful "U" Tube Heater
First Major Improvement in Quartz Immersion Heaters in 35 years

- **HEATS INSTANTLY**
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- **100% THERMAL AND MECHANICAL SHOCK-PROOF CONSTRUCTION**
- **GUARANTEED TO OUT-PERFORM AND OUT-LAST ALL OTHER QUARTZ HEATERS**

Big Savings For You With Type "U" Immersion Heaters

You get much longer service life with greatly improved accuracy and heating efficiency from the new Type "U" Glo-Quartz Heaters. Order today—and save time, trouble, money!

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Industry News

Norton Licenses Bettinger

The granting of the first license to the Bettinger Corporation for application of the Norton Company's new series of coatings, designed to extend the use of metals to higher temperature ranges, has been announced.

Bettinger, one of the country's leading companies in the production and application of high temperature ceramic coatings, worked closely with Norton in formulating the new coatings, called Rokide series. The new coatings will complement and diversify Bettinger's position in the coating of metals exposed to high temperatures.

Norton granted its first license to Bettinger on the basis of the experience Bettinger has gained in the four years it has worked with high temperature ceramic coatings and their application on aircraft and industrial parts exposed to temperatures in excess of 2000° F. In addition to using coatings developed by the National Bureau of Standards and other companies, Bettinger has also formulated its own coatings for various uses.

Stanley Chemical Appoints Midwestern Distributor for Plating Rack Coatings. The Stanley Chemical Company of East Berlin, Conn., has named the Russ-Howell Agency, with main offices at Grand Rapids, Mich., to be distributor for the entire Stanley line of plastisol coatings for plating racks and tanks in the states of Michigan, Ohio, Indiana, Illinois, and Wisconsin.

The Russ-Howell firm will warehouse these materials along with a line of Stanley wash primers and other custom finishes.

Supersheen Barrel Finishing Award Won by New York Aircraft Parts Manufacturer. Winner of the first Supersheen award for the largest total dollar savings with Almco barrel finishing equipment is the Le Roy Machine Company, Le Roy, New York.

Savings reported by Le Roy amount to over $124,000 annually over previous deburring method. This was accomplished by the installation of one Supersheen Fixture Barrel, used for deburring compressor rotor discs for jet aircraft.

Not only does the barrel finishing meet rigid Air Force specifications on the break-edges, but deburring time has been cut from 18 hours to 4 hours per disc, increasing production 450 per cent.

As winner of the quarterly 100 dollar award, Le Roy is eligible for the 250 dollar annual prize which is awarded to the company making the greatest total dollar saving over the 12 month period.

Almco's new contest starts Sept. 11 and ends Dec. 31. It has been arranged so that companies of every size will have a fair chance to compete; a 100 dollar award will be given for the company reporting the greatest percentage of saving from barrel finishing a part as compared to former methods. There also is an annual 250 dollar award for this division.

Also, each contestant who returns a completed entry blank will receive an attractive carry-type food and drink cooler. Awards are made either in the name of the company or the finishing personnel involved.

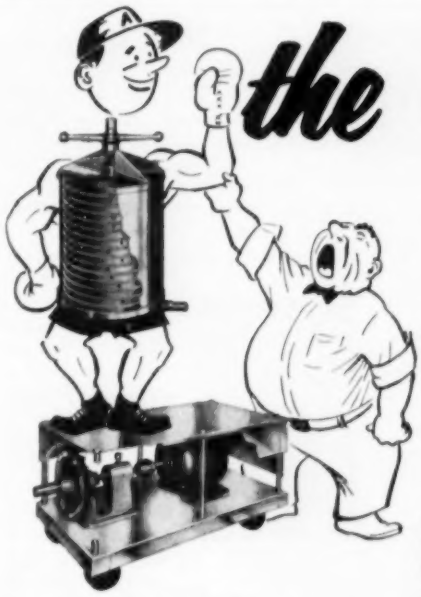
Entry blanks for the new contest period can be obtained by writing Almco, Albert Lea, Minn.

American Agile Corporation Announces New Major Plant Addition. The addition of more than 10,000 square feet of manufacturing and research area to its present facilities was announced by Dr. J. A. Neumann, president of the American Agile Corporation, Maple Heights (Cleveland), Ohio. The new addition, when completed early this fall, will nearly double the existing plant facilities.

Agile is world renowned as one of the leading plastic resin converters using such manufacturing processes as extrusion, injection and compression molding, forming and fabricating. It serves the chemical, food, electrical and metalworking industries with such items as self-supporting, noncorrosive tanks; fume exhaust systems; fume scrubbers; nontoxic tanks and vessels; nonbreakable laboratory ware; and a wide variety of shapes such as sheet, rod, tubing, and the like.

Sharples Integrated as Operating Division of Pennsalt Chemicals. Sharples Chemicals Inc. was dissolved as a corporation July 1 and became an operating division of the **Pennsylvania Salt Manufacturing Company,** president William P. Drake has announced.

Sharples was acquired by Pennsalt Chemicals through an exchange of stock in 1951.

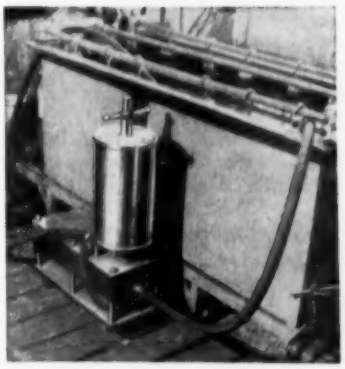


the Winner

on all counts

against pitting, spotting, rejects and reworking

EVERY TIME



The Alsop "Sealed-Disc" Filter is a sure winner *every time* that it's called on to knock-out dirt, sludge and even the invisible impurities from your Plating Solutions.

"Sealed-Disc" Filters remove more impurities with less effort and in no time at all. That's because they're designed to meet Plating room requirements. They're smaller than conventional filters, yet capable of handling equal volumes of solutions. It will pay you to invest in a *Winner*—"Sealed-Disc" Filter. You can depend on its proved "knock-out" performance for continuous or now-and-then operations. See your regular Plating Supplier or write for a Catalog—it's free.

You can depend on a "Sealed-Disc" Filter for better finished plated work with savings in time and labor.

ALSOP

ENGINEERING CORPORATION

1009 FINE STREET • MILLDALE, CONNECTICUT

Positive Filtration

FIRST STEP IN CUTTING COSTS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 908.

Personals

Ray N. Griffin, vice-president of Bart Manufacturing Corporation, Belleville, N. J., fittings and sheets, announces the appointment of **James P. McNally** as sales manager.

McNally

McNally has been with Bart Manufacturing Corporation for the past year and has actively conducted the sales of Bart LECTRO-CLAD pipes and fittings since November 1954. An alumnus of Syracuse University and the University of Wisconsin, with a major in Metallurgical Engineering, McNally has also served Bart Manufacturing Corporation in the capacity of metallurgical technical adviser on the forming and fabrication of nickel plated steel, and has initiated and directed the firm's welding research program.

McNally has also been charged with the responsibility of coordinating various aspects of the recently announced exclusive sales agreement with Colorado Fuel and Iron covering the distribution of Bart LECTRO-CLAD steel sheets, and will continue to serve as liaison between managements of both companies.

Previously affiliated with the Carrier Corporation as production metallurgist, McNally did extensive work in the solution of metallurgical problems in the manufacture of air conditioning equipment, Atomic Energy Commission Axial Flow Compressors, Air Force Jet Engines, and Army Tank Hulls.

McNally is a member of the American Ordnance Association; American Society for Testing Materials; American Society for Metals; American Welding Society; American Electroplaters' Society. He has also served on the Conservation of Nickel Committee, Department of Commerce, B.S.D.A., Washington, D. C.

One of McNally's first moves as sales manager will be to expand the field sales force of Bart Manufacturing Corporation to assure adequate national coverage for his firm's LECTRO-CLAD pipe and fittings.

James A. Hughes, vice-president and general manager of the Bryant Heater Division of Affiliated Gas Equipment, Inc., for the past five years, has been elected treasurer of Diamond Alkali Company, it was announced by **John A. Sargent,** President, following action by the Board of Directors.

Hughes succeeds **Arthur W. Crossley'** treasurer since July 1, 1948, who is leaving Diamond at an undetermined date, at which time he will announce his future plans.

To his new post at Diamond, Hughes brings a background of 15 years of business administration and general management experience in the shipbuilding, oil field supply and consumer goods industries. From 1940 to 1944, he was associated with the American Shipbuilding Company, Cleveland. Then he joined Dresser Industries, Inc., as an administrative executive specializing in the fields of industrial relations and law.

When Dresser sold its Bryant Heater Division to the newly established affiliated organization in 1949, Hughes was named vice-president and general manager of its largest divisional unit.

Hughes, 42, earned his A.B. degree in 1935 from Dartmouth College, and in 1938 received an LL.B. degree from Yale University Law School. He is a member of the Union and Kirtland Country Clubs.

Curtis B. Hoffman has been appointed vice-president-sales of Brush Electronics Company, Cleveland, Ohio, it was announced by **Douglas C. Lynch,** president. Brush, a division of Clevite Corporation, manufactures electronic instruments and is the country's largest producer of high-quality magnetic recording heads and piezoelectric crystals.

Hoffman

Lynch stated that "the appointment of Hoffman, who has had long experience as sales executive in the mechanical and technical fields and as a consultant to management in industrial marketing, is another step forward in Brush's expansion program."

In addition to his administrative duties, Hoffman will direct the marketing of Brush Electronics Company's industrial and research instruments, electronic components and new electronic memory devices which are the basis of electronic computers and automation equipment.

Hoffman attended Washington University School of Engineering, served as Electronics Officer in the U. S. Navy during World War II and was most recently assistant to the president of Foote Bros. Gear and Machine Corporation in Chicago.

He is a member of the National Sales Executives organization and the Executive Club of Chicago.

L. V. Nagle, executive vice-president of the Udylite Corporation, announces the appointments in the Udylite Division as follows:

L. Eugene Drury has been named facilities manager in charge of Udylite supplies business, maintenance of buildings and equipment, supervision of new buildings and additions and supervision of transportation including truck and car fleets in the Traffic Department. Drury has been employed continuously by Udylite since 1929 in various factory supervision capacities.

Drury

William J. Blashill has been named manager of manufacturing with the responsibility of manufacturing, quality control and delivery of all Udylite equipment. Blashill is a graduate of the University of Detroit with a Bachelor of Science Degree in Mechanical Engineering. His past experience includes acting as a works manager for Atlas Enameling of St. Louis, as an engineering consultant with Stevenson Jordon and Harrison from their Cleveland office and production control with Vickers, Inc., of Detroit. Blashill joined Udylite in 1950 and served as an industrial engineer since that time.

Blashill

Louis J. Minbiole, Jr., has been appointed sales manager of the Udylite Division of the Udylite Corporation. Minbiole has a Bachelor of Science Degree in Chemical Engineering from Wayne University and a Master of Science Degree also in Chemical Engineering from Massachusetts Institute of Technology. Before coming to Udylite in 1946 he worked with Buick Motor as a research engineer devoting his time to all types of surface coatings. He served Udylite as the sales engineer until 1953 when he came into the Detroit office as assistant sales manager of the Udylite Division. Minbiole is a Past President of the Saginaw Valley Branch of the American Electroplaters' Society.

Minbiole

Personals

The appointment of **R. F. Edgar** as industrial sales manager of the Warner Electric Brake & Clutch Company, Beloit, Wis., has been announced by **Norman K. Anderson,** vice-president, sales.

Edgar

Edgar, who attended Beloit College and the University of Wisconsin, joined Warner in 1947. He served as a sales engineer and in 1954 was made Midwest Regional Manager for the firm.

Edgar will be responsible for planning and controlling marketing functions.

The Permutit Company, New York, N. Y., manufacturers of ion exchangers and water conditioning apparatus for commercial and industrial applications, has announced the appointment of **George W. Taylor** as chemical research engineer in the Special Applications Department. In this capacity, he will devote full time to the application of ion exchangers and equipment in fields other than water conditioning.

Taylor

Taylor received his Bachelor's degree in Chemical Engineering from Princeton University in 1948 and his Master's degree from Lehigh University in 1951. Thereafter, he was employed at the Johns-Manville Research Center in the research and development of friction materials. He is a member of the American Chemical Society and American Institute of Chemical Engineers.

The Permutit Company have also announced the appointment of **William C. Neumann** as chemical research engineer in the Special Applications Department.

Neumann

Neumann is, at present, working toward his New York State Professional Engineer's license and received his Bachelor's degree in Chemical Engineering from New York University in 1952. Upon graduation, he was employed in the research and development department of Stein-Davies and Co., Long Island City. He is a member of the American Institute of Chemical Engineers and the National Guard.

Ken R. Gerlach has been appointed executive vice-president of Bogue Electric Manufacturing Co., Paterson, N. J., it was announced by **E. F. Schinman,** president. Gerlach comes to Bogue from the Sperry Gyroscope Company with extensive experience in the application of precision motor-generator equipment.

Gerlach has been associated with the electric and instrument industry for the past 25 years in scientific apparatus, radio, communications and utility manufacturing. An authority in the field of quality control, he rendered nation-wide assistance during World War II to companies starting in the vital new field of gunfire control manufacturing by establishing technical and production standards to satisfy rigid Federal requirements.

Prior to joining the Sperry Gyroscope Company, Gerlach was associated with the Colonial Radio Company, and previous to that, the Westchester Lighting Company.

Orville T. Barnett has been promoted to assistant manager of the metals research department at Armour Research Foundation of Illinois Institute of Technology, Chicago.

One of Barnett's responsibilities will be to help develop projects for new areas of research, according to **Robert A. Lubker,** department manager.

Dr. Donald J. McPherson, who was appointed assistant manager of the metals department in May, will concentrate on increasing the technical competence of the department and directing its personnel recruiting program, Lubker said.

(*Continued on page 1094*)

to Brilliant, Durable Zinc Electrodeposits

From surface preparation to finished product, this 3 step Promat process assures brilliant, corrosion resistant zinc deposits at high current densities.

PREPARE WITH PROMAT

7073 addition agent. For muriatic and sulfuric acid pickling solutions.

PLATE WITH PROMAT

C42 and B4M bright addition agents. Permits current densities up to 200 amps per sq. ft. Improves conductivity for excellent distribution of fine grained, high luster, durable deposit.

PROTECT WITH PROMAT

PROSEAL 9 and 2B leach . . . Easy and inexpensive to use and provides maximum control over uniform application of film in full bright or bronze phase.

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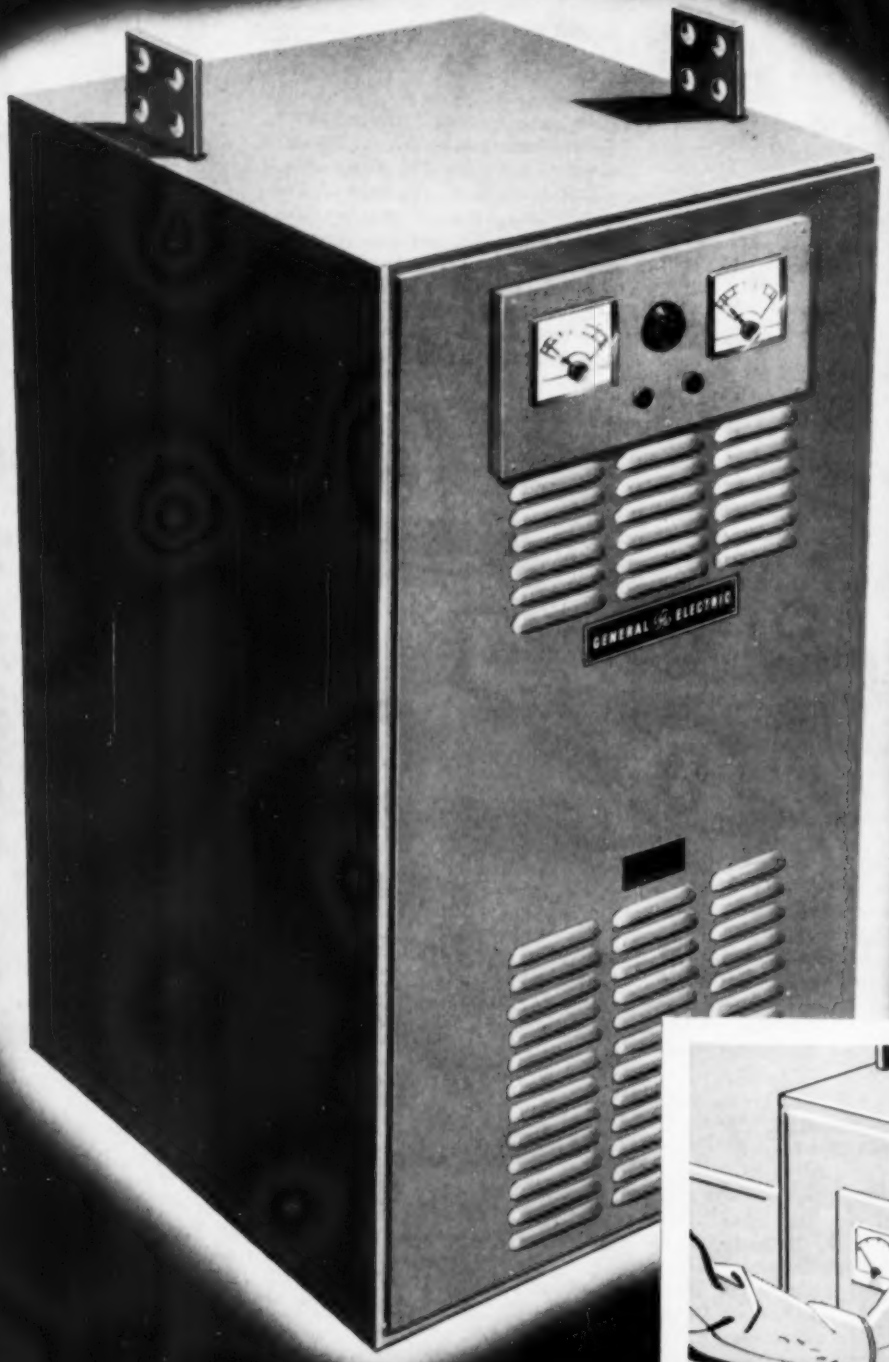

SINGLE-KNOB CONTROL provides easy finger-tip setting adjustments.

NEW G-E Germanium Power Supply for Plating Cuts Your DC Power Costs Three Ways

New germanium unit combines high efficiency, ease of installation, and low maintenance—to save you plating dollars

This new General Electric 1000-amp germanium plater, backed by four years of germanium experience, saves you money three ways:

- No special foundation is needed with these compact, lightweight units. Also, only one side of the unit need be clear. Both of these features help reduce installation time and costs.
- Germanium's inherently high over-all conversion efficiency means reduced power costs.
- Germanium rectifiers do not age, and a minimum of moving parts is used. Thus, maintenance is reduced to a fraction of what it is with other types of conversion equipment. Over three years of continuous life testing at General Electric, and in industry, reveal no significant decrease in efficiency due to aging.

OUTSTANDING FEATURES AVAILABLE in this new germanium plater include: down-draft air cooling, single-knob finger-tip control, and complete control flexibility. In addition, these 1000-amp, 12-volt units offer smooth, stepless control. And hermetically sealed rectifier cells promote long life in corrosive plating-room environments.

G.E.'s down-draft air cooling draws air in horizontally through the front panel, minimizing dust and dirt intake.

Single-knob finger-tip control means simplified adjustment. Also, it eliminates multi-knob fumbling and possible transformer unbalance.

Complete control flexibility permits the addition of automatic control in the future without complete replacement of the manual control.

This new plater is the most recent addition to an experience-proven line of G-E germanium power supplies. To date, over 7000 kilowatts of G-E germanium rectifier power supplies have been put in operation. This is the equivalent of more than 1,000,000 amperes at six volts, the normal plating voltage.

FOR ADDITIONAL INFORMATION on G-E germanium power supplies for plating, contact your nearest authorized G-E plating agent, or write Section 463-12, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

EASE OF INSTALLATION, and the fact that only one side of the rectifier need be clear, helps eliminate layout problems.

NEW LOW PRICES

Announcing more good news for plating power supply users. New *low* prices are immediately available on the complete General Electric line of selenium and copper-oxide plating power supplies. G.E. offers you a complete line of plating power supplies to meet practically every plating need.

MEAKER PLATING MACHINES

USED IN WORLD'S LARGEST PLATING PLANT

1200 AUTOMOBILE BUMPERS PLATED EVERY HOUR

The Meaker Company is proud of its contribution in designing and building the plating machines for this plant, put into production shortly after the beginning of the year. The large automobile manufacturer now plates all of the bumpers for its entire production in the one plant.

This is another example of Meaker's engineering and manufacturing ability which has been demonstrated so successfully over the past half century.

MEAKER

Engineered plating equipment is designed for highest efficiency in your particular operation. Call or write today and have a representative from our nationwide sales and service organization survey your problem with you at no obligation.

MEAKER PRODUCTS

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• Full Automatic and Semi-Automatic Plating Machines • Strip Steel Plating Equipment
• Wire Galvanizing Equipment • Batch Type Plating Machines • Pickling Machines
• Processing Conveyors • Motor Generators for Plating • Rectifiers for Plating

Personals

A 1933 graduate of Illinois Tech, Barnett joined the Foundation in April 1954, as supervisor of welding research in the metals research department. He had been regional sales manager of the A. O. Smith corporation, Chicago, for the previous two years.

An expert in the field of welding and metallurgy, Barnett spent two years with the Carnegie-Illinois Steel Corporation, Chicago; four years as engineer with Black, Sivalls, and Brysone, Inc., Oklahoma City, and 11 years as district manager in Pittsburgh and New York for the Metal and Thermit Corporation.

A member of the American Welding Society and the American Society for Metals, Barnett has written more than 100 articles for publication in the metallurgy field.

Ernest Nuber has been promoted to general field sales manager for the Bristol Company, according to an announcement by **Harry E. Beane,** vice-president in charge of sales.

Nuber

Nuber joined the Bristol sales engineering organization in 1929. He was made Pacific Coast Manager in 1934 and was later brought to the home office at Waterbury to become export manager. In 1948 he was promoted to the position of manager of the company's application engineering department and has held the position of sales manager since the first of 1954.

Born in Brooklyn, N. Y., Nuber studied electrical engineering at Brooklyn Polytechnic Institute. Before joining the Bristol Company he was associated with the New York Edison Company in their General Test and Engineering Department and later with the Western Electric Company and the Board of Transportation of New York City.

John F. Siefen, president of the J. J. Siefen Company, has resigned his Presidency of the Company and is no longer connected with the J. J. Siefen Company. His resignation was effective as of July 20, 1955.

Mrs. I. E. Siefen wishes to announce the Company standards and policies will not change and business will be conducted as before.

ALWAYS FINISHES FIRST

and cuts costs two ways because it's completely automatic!

fast cutting, easy cleaning with

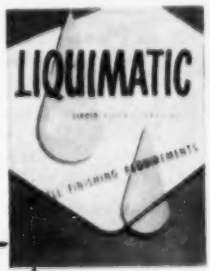
Liquimatic®

the perfect liquid compound for all metal finishing

What are the two big cost factors in your buffing room? Chances are *buff life* figures big when you're talking production costs . . . and the second big factor is *production time* itself. Liquimatic Application Systems are licking these two cost problems in buffing rooms all over the U. S.—because Liquimatic is automatic. An electrically timed system feeds Liquimatic Buffing Compound to the buff in the exact amount to give you the exact cut you need. Because the buff is continually lubricated, buff life is extended up to 400%!

And with Liquimatic there's no compound wasted, no nubbin problem, no hand application, no changing bars—think of the cost savings you can effect in *your* buffing room with these advantages! Savings in buff life alone can soon pay for a complete Liquimatic Application System . . . a system that will continue to save you money – *automatically*.

Check the other features of Liquimatic Buffing Compound . . . then write today for your free copy of Liquimatic's big, new folder that tells the whole cost-saving story of Liquimatic in *your* buffing room.



These additional Liquimatic features mean real savings in terms of time, money, safety—

- longer buff life
- completely automatic
- fast cutting
- easy cleaning
- non-settling
- high flash point
- long storage life
- sprayable viscosity
- adhesive slow-wearing buff face

Liquimatic *. . . gives more buff mileage*

PLATEMANSHIP

Your H-VW-M combination—of the most modern testing and development laboratory—of over 80 years experience in every phase of plating and polishing—of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING CO. • MATAWAN, N. J.

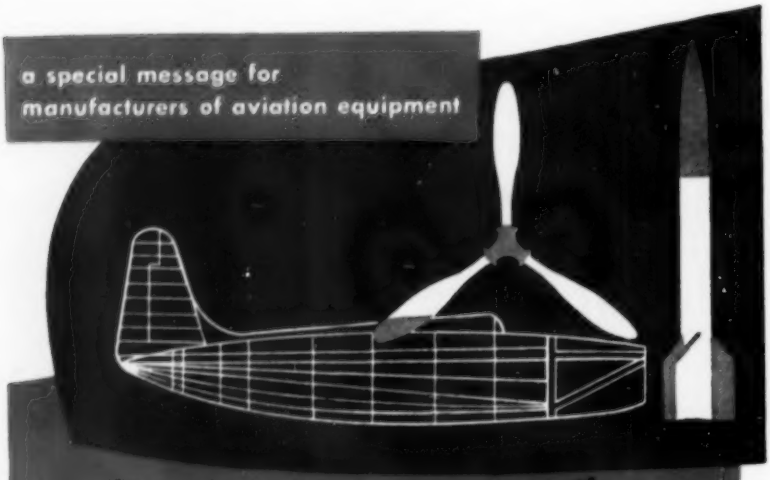
Plants: Matawan, N. J. • Grand Rapids, Mich.

SALES OFFICES: Anderson (Ind.) • Baltimore • Beloit (Wisc.) • Boston Bridgeport • Chicago • Cleveland • Dayton • Detroit • Grand Rapids • Los Angeles • Louisville • Matawan • Milwaukee New York • Philadelphia • Pittsburgh • Plainfield • Rochester St. Louis • San Francisco • Springfield (Mass.) • Utica Wallingford (Conn.)

H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

a special message for
manufacturers of aviation equipment



need a finish for
light metal parts?

specify
IRIDITE®

Here's the finish that combines corrosion resistance and paint adherence with extreme ease of application. It can be welded or soldered with no difficulty and presents no problem in "patching" scratches, marks or scraped sections. Here's what you can do with Iridite:

ON ZINC AND CADMIUM you can get highly corrosion resistant finishes to meet any military or civilian specifications and ranging in appearance from olive drab through sparkling bright and dyed colors.

ON COPPER . . . Iridite brightens copper, keeps it tarnish-free; also lets you drastically cut the cost of copper-chrome plating by reducing the need for buffing.

ON ALUMINUM Iridite gives you a choice of natural aluminum, a golden yellow or dye colored finishes. No special racks. No high temperatures. No long immersion. Process in bulk.

ON MAGNESIUM Iridite provides a highly protective film in deepening shades of brown. No boiling, elaborate cleaning or long immersions.

AND IRIDITE IS EASY TO APPLY. Goes on at room temperature by dip, brush or spray. No electrolysis. No special equipment. No exhausts. No specially trained operators. Single dip for basic coatings. Double dip for dye colors. The protective Iridite coating is not a superimposed film, cannot flake, chip or peel.

WANT TO KNOW MORE? We'll gladly treat samples or send you complete data. Write direct or call in your Iridite Field Engineer. He's listed under "Plating Supplies" in your classified phone book.

Iridite is approved under government specifications

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD

Manufacturers of Iridite Finishes for Corrosion Protection and Paint Systems on Non-Ferrous Metals, ARP Plating Chemicals.
WEST COAST LICENSEE: L. H. Butcher Co.

Personals

Fred Zajac has been appointed Detroit service engineer for Acheson Colloids Company, Port Huron, Mich., replacing **Frank M. Hunter,** who is returning to the company's headquarters at Port Huron where he will supervise the laboratory phase of Acheson's Sales Engineering program.

Servicing all of Northern and lower

Zajac

Hunter

Michigan, with headquarters at Detroit, Mich., Zajac will provide technical assistance to industries using colloidal graphite and other Acheson products in their operations.

After receiving a B.S. degree in Industrial Engineering from the Lawrence Institute of Technology, Zajac worked for the Jergens Tool Specialty Co., as a sales engineer. During World War II, he served with the Coast Guard and Navy in the European Theater of Operations. He is a member of the American Society of Tool Engineers.

Zajac, a native of Dearborn, Mich., is treasurer of the Dearborn-Lindbergh School Parent Teachers Association.

Hunter, after receiving B.S. and M.S. degrees in chemistry from Michigan State College, worked for the Chrysler Corporation, Hudson Motor Company and the Mueller Brass Company, among others. During World War II, he was with the Chemical Warfare Service. He joined the Acheson Colloids Company in December, 1953, and has been sales engineer in the company's Detroit office.

The promotions of two sales executives of the Pennsylvania Salt Manufacturing Company have been announced by **Albert H. Clem,** general manager of the Chemical Specialties Division.

Effective July 1, **J. Stanley Hall,** sales manager of Pennsalt's laundry and dry cleaning products department, becomes sales director of the Chemical Specialties Division. In this newly created position, Hall will be responsible for the national sales activities of the metal processing chemicals, B-K food sanitizing products, corrosion engineering, household products, and laundry and dry cleaning chemicals departments.

Personals

Paul C. Hurley, manager of advertising and sales promotion since 1950, succeeds Hall as sales manager of the laundry and dry cleaning department. Prior to assuming his present duties, Hurley was a member of Pennsalt's laundry and dry cleaning sales staff and served successively as sales representative, sales training supervisor, and merchandising manager.

Hall, a graduate of the University of Massachusetts, joined the Pennsalt chemical specialties organization in 1932. He has been a sales manager since 1943. Active in the Laundry and Dry Cleaners Allied Trades Association, he served six years as a board member and two terms as its president. He is also a member of the Philadelphia Sales Managers' Association.

Hurley, prior to joining Pennsalt in 1943, was associated with the Kansas City Laundry Service. He has had extensive experience in both sales and operations and is widely known throughout the industry. Early experience in training and sales promotion activities was acquired during his association with the Missouri Aviation Institute, Trans-World Airlines, and the Coca Cola Company.

F. H. Maas is superintendent at Wagner Electric Corporation, Edwardsville, Ill. **M. H. Palm**, the superintendent preceding **Maas,** was transferred to St. Louis. His address is Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

Bettes

Brown

J. A. Bettes, Jr., sales manager since 1939 of the Asbestos Textile Division of Raybestos-Manhattan, Inc., has been made manager of the division.

Succeeding him as sales manager is **J. A. Brown, Jr.,** who has been assistant sales manager since 1952.

Bettes will also retain his post as manager of the Revolite Division to which he was named in May when Raybestos bought the Revolite organization from the Atlas Powder Company. He has been in the asbestos textile industry for 26 years and is a graduate of the Philadelphia Textile Institute.

Brown, a graduate of the University of Pennsylvania Wharton School, has been in the industry since 1937. He joined the Asbestos Textile Division as Philadelphia district manager in 1947, became assistant sales manager five years later. He served with the U. S. Air Force from 1942 to 1946, when he was discharged with the rank of major.

Both men will continue to have their offices at the division in Manheim.

John B. Davies, manager of industrial sales, Mine Safety Appliances Company, Pittsburgh, was elected president of the Industrial Safety Equipment Association at the group's recent annual meeting.

Davies, a native of Pittsburgh and a veteran of World War I, is a graduate of Carnegie Institute of Technology. He joined Mine Safety as a chemist in 1919, five years after the company was founded. Before assuming his present position, Davies was assistant sales manager.

He is a member of the American Society of Safety Engineers, the American Industrial Hygiene Association, and the International Association of Fire Chiefs. He is a past president of the Veterans of Safety and a director of National Sales Executives, Inc.

Stanley S. Krentel was recently elected vice president and sales manager of MacDermid Western Incorporated, Farmdale, Mich., a wholly owned subsidiary of MacDermid Incorporated of Waterbury, Conn.

Krentel is a chemical engineering graduate of Michigan State University and has been with MacDermid for 10 years, most recently as manager of the Michigan sales territory.

NO TANK LINING PROBLEMS HERE...

You see, most thermoplastic sheet linings must be installed by factory-trained applicators using special equipment, but not . . .

RESILON 44

Untrained workmen — shown the simple steps — can install Resilon 44 using only a torch and a trowel. No adhesives or vulcanizing are needed. Simple "heat welding" bonds Resilon 44, bonds it so tightly to properly prepared steel or concrete, that the bond is as strong as the material itself. Joints are filled with Resilon 44 strips, then "heat welded" and smoothed. The result is an impermeable, seamless membrane with excellent resistance to acids and alkalis at temperatures up to as high as 150°F. And at an installed price way below comparable linings of equal quality. (If you prefer, we'll install it and you'll still save money.)

You'll want specific information on this remarkable lining material so write today . . .

and get this

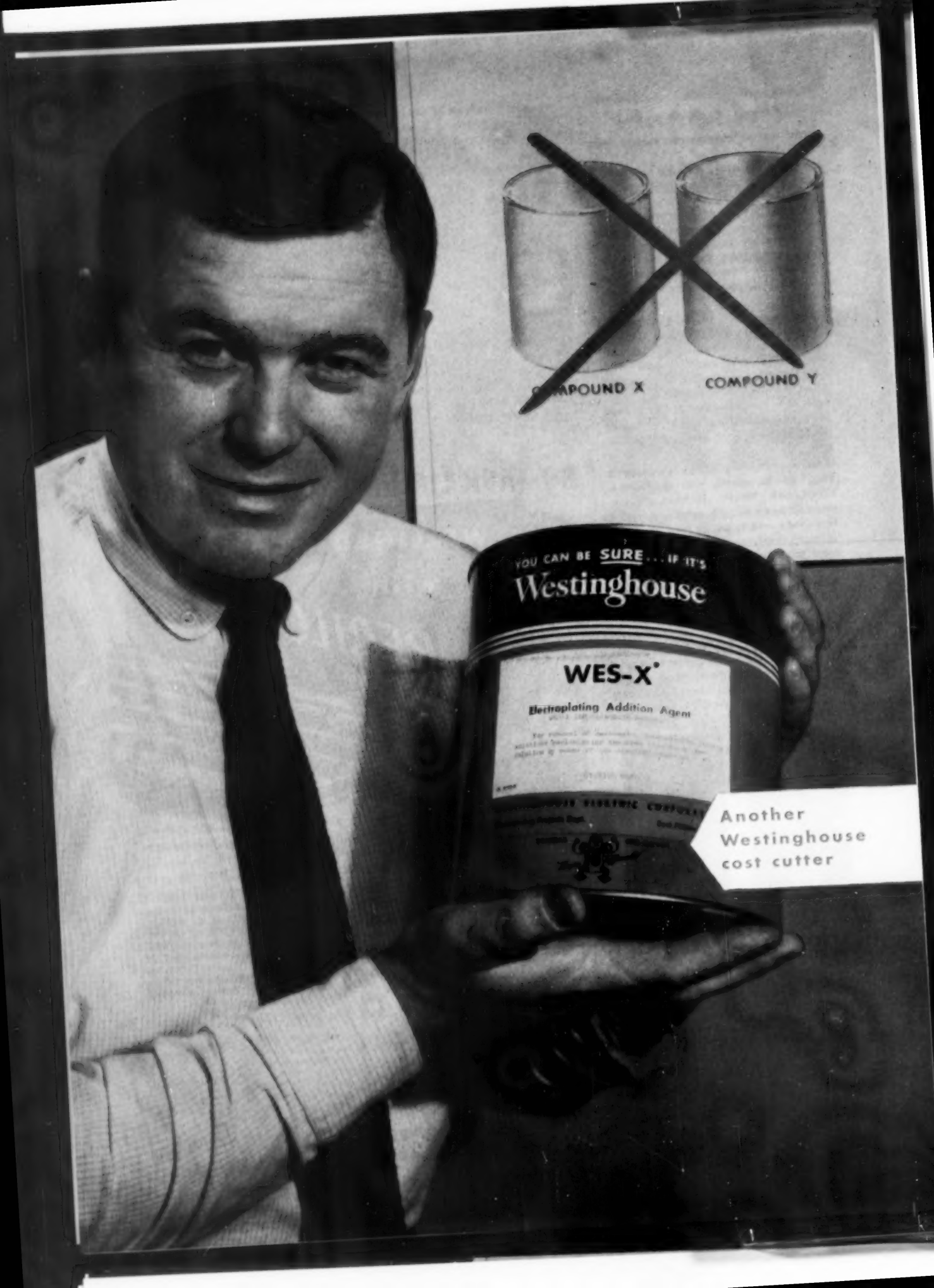
Bulletin RL-510 gives the facts on Resilon 44, including a table of chemical resistance.

We make and install many types of linings for all kinds of corrosive service. Our engineers will be glad to consult with you.

U. S. STONEWARE
AKRON 9, OHIO

134E

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 917.


COMPOUND X
COMPOUND Y
YOU CAN BE SURE... IF IT'S
Westinghouse
WES-X®
Electroplating Addition Agent
Another
Westinghouse
cost cutter

Now! Control both carbonate and cyanide with one compound . . . WES-X 150

New and exclusive 2-in-1 carbonate remover also replenishes cyanide; is the easy, low-cost way to keep any metal cyanide plating bath at right concentration for high-speed plating.

Westinghouse has developed a new and far better way to control cyanide plating. It is WES-X® 150—an efficient and economical compound which removes carbonates, helps eliminate certain contaminants; and maintains or increases uncomplexed or free cyanide at the same time.

Here are the big advantages of WES-X 150:

- High reaction efficiency—1.1 oz of WES-X 150 removes 1 oz of carbonates.
- Economical—1 oz of WES-X 150 yields 1.0 oz free cyanide.
- Precipitated particle size greater than with other methods—less work to handle and filter precipitate.
- Will not upset hydroxide control.
- Supplied in convenient metal drums.

It is not necessary to batch treat the whole solution when WES-X 150 is used. And once WES-X 150 gets carbonate concentration within required limits for high-speed plating, it is an easy and low-cost means to control this concentration with WES-X 150 . . . the simplest and cheapest way to get the most out of your plating time!

Let a Westinghouse sales engineer help you put this new compound to work in your operation. All it takes is a free survey of your plating process and a specific recommendation on its application. Call your nearest Westinghouse sales office or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10442

YOU CAN BE SURE . . . IF IT'S

Westinghouse

Westinghouse offers metal finishers a unique combination of advanced WES-X Compounds and application service. This Pilot Plant electroplating lab gives new processes a head start—makes them commercially sound. WES-X 150 was proved here. WES-X 100C, 102, 303A and 304 are other compounds.

This is an example of "PR"—Periodic Reverse—Plating. Bottom row shows superior leveling characteristics of "PR" . . . appearance is equal to buffed castings—with *no* prefinishing. "PR" Plating is one of the many *new* ideas and compounds to come from Westinghouse development.

Trade Literature

Please use Reader Service Card to obtain any item in this section

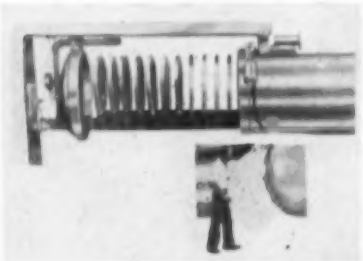
L—900. Sel-Rex High Speed Silver Plating Process—A new 4-page booklet, describing the features and advantages of the Sel-Rex High Speed Silver Plating Process for industrial applications, has just come off the presses.

Primarily a "technical write-up," this new literature contains much valuable information including bath preparation and maintenance, a step-by-step procedure for determining metallic silver content in potassium silver cyanide, and an easy-to read Silver Plating Time Table for specific thickness requirements.

Also described in the booklet is the new Sel-Rex Silver Brightener, for industrial use, which permits the electrodeposition of silver in a uniformly smooth surface, fully maintaining the desired ductility and hardness.

L—901. Sel-Rex D-C Power Conversion Equipment Catalogue—The Bart-Messing Corp., pioneers in the development of d-c power conversion equipment for over a decade, has prepare a 12-page illustrated catalogue entitled "A Guide to Better Plating Power," which covers their complete line of Selenium Rectifiers.

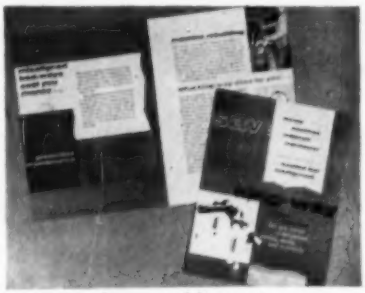
Illustrated and described are basic and custom designed units with d-c output ratings ranging from 0.5 to 50,000 amperes, available to either air-cooled or completely sealed water or oil-cooled models, with all types of automatic controls.



The Horizontal Story

L—902. Industrial Filter and Pump Offers Bulletin NH-155 on Horizontal Filters—New features that speed up operation and simplify recovery or disposal of filter cake are now being built into Industrial's line of horizontal filters. These include a quick opening hydraulically operated and sealed door, and filter leaves which lift out and snap back into place without bolts. An optional vibrating attachment shakes off the filter cake, eliminating the need for scraping or shaking by hand. Standard features also include power or manual withdrawal of leaf assembly, completely exposing all the leaves; bottom outlet; air drying facilities; and optional leaf spacing. It is all described in Bulletin NH-155.

L—903. Free Booklet on Simplified Drafting—A 36-page booklet on Simplified Drafting has just been released by the American Machine & Foundry Company. Authored by J. H. Bergen, Standards Administrator of AMF's Engineering Division, the 8½ by 11 inch paperbound booklet presents in a clever yet dramatic manner eleven common sense rules for simplifying drafting practices.



Lines on Alignment

L—904. Alignment—Literature describing the composition, advantages and specifications of the new King-Way Alignment Instrument has been issued by the King Instrument Co., Minneapolis, Minn.

The 4-page brochure discusses the expense that results from misaligned bedways, how the instrument may be used in preventive maintenance and machine rebuilding, how it operates and how it is applied. Space is devoted to the instrument's extreme accuracy and ease of operation.

L—905. Metals, Alloys, Processed Minerals—Producers of chromium metal and a wide range of master and powdered ferro alloys, the Shieldalloy Corporation has announced a new booklet outlining operations and products made at its Newfield, N. J., plant.

The booklet demonstrates Shieldalloy's use of modern methods and facilities in the processing of welding rod materials, master alloys, and other specialized metallurgical and ceramic products.

Featured in the booklet is a handy, detailed listing of applicable products to fit specific industrial needs.

L—906. Waste Treatment of Cyanides, Chromic Acid—Processes for treating highly toxic cyanides and chromium compounds in industrial wastes are described in a booklet recently issued by Fischer & Porter Company, Hatboro, Pa.

By means of flow diagrams the 16-page booklet illustrates most common methods of treating cyanide and hexavalent chromium wastes and the applications of Fischer & Porter instrumentation for controlling the processes. Instruments used are illustrated and described.

L—907. "Glass Fiber Filter Discs"—A 4-page, 2-color bulletin covering a complete range of septa for every commercial use, has just been issued by Friedrich and Dimmock, Inc., Millville, N. J.

The bulletin pictures and describes filter discs and gives the shapes, fiber diameters, disc diameters, disc thicknesses and disc densities available.

Besides the filter discs, the bulletin describes other glass fiber products filter rolls, skeins and mats.

L—908. Precision Cleaning and Finishing—American Wheelabrator & Equipment Corp., Mishawaka, Ind., is publishing a quarterly brochure devoted to the subject of precision cleaning and finishing. It deals with the wet abrasive blast cleaning process.

The first issue contains a complete discussion of the scope of the wet blasting process and the diversity of applications that it is capable of serving.

Also included are case history items about its use for the following applications: Glare-free finishing for precision instrument dials, reconditioning rubber molds, reconditioning various items of plant equipment, and increasing cutting tool life. Also included is a discussion of wet blast abrasives. Other subjects will be covered in forthcoming issues.

L—909. Industrial Heating Facts—A new handbook designed to provide plant management and engineers with basic concepts of industrial heat processing and heat control is now being distributed on request by the Michigan Oven Company of Detroit.

Advance Illustrates

L—910. Tooling Methods and Facilities—A new 12-page bulletin, "Advance Tooling Methods," has just been published by The Advance Die and Tool Company. The new bulletin illustrates and describes the facilities and equipment available at Advance and also pictures an assortment of stamped and formed jobs produced with Advance dies and tools.

The subjects illustrated include a range top, heater cabinet, automobile grill bar, refrigerator door panel, steam iron cap and other appliance parts. Because of the ingenious tooling employed, each of the parts shown was stamped, drawn or formed with fewer steps and operations than formerly required.

HOW TO INCREASE YOUR REJECTS!

Sounds ridiculous, doesn't it? No one wants to increase rejects . . . but perhaps that's just what you're doing without realizing it. Electro-cleaners are *not* designed to remove heavy contamination carried over from the soak tank—the soak tank must do its job. Carry-over contamination cuts down current-carrying capacity which reduces the efficiency of electro-cleaners. And rejects go up if you force electro-cleaners to do the soak cleaning job.

For controlled foaming cleaners that do their job in the soak tank . . . rely on Diversey 909 and 404.

DIVERSEY 909 is a non-caustic, mildly alkaline cleaner for *all* metals. Exceptional wetting, emulsifying and dispersing action provide thorough cleaning and free draining, leaving work *free of contamination.*

DIVERSEY 404 is non-caustic, but more alkaline. Has excellent wetting, emulsifying, dispersing and water softening action. Designed for heavier types of contamination and barrel cleaning operations.

Write today for an on-the-spot demonstration of either of these outstanding cleaners.

THE DIVERSEY CORPORATION

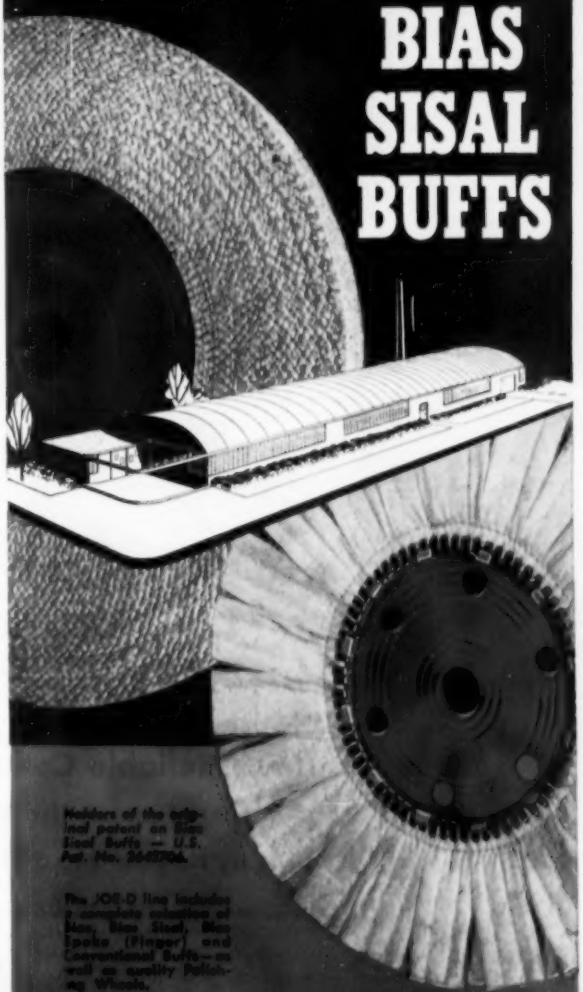
1820 Roscoe Street, Chicago 13, Illinois

(In Canada: The Diversey Corporation (Canada) Ltd., Port Credit, Ont.)

USE READER SERVICE CARD; INDICATE A 919.

The "House that Sisal Built"

JOE-D . . . Originators of BIAS SISAL BUFFS



Holders of the original patent on Bias Sisal Buffs — U.S. Pat. No. 2662706.

The JOE-D line includes a complete selection of Bias, Bias Sisal, Bias Spoke (Finger) and Conventional Buffs—as well as quality Polishing Wheels.

Since its founding, the JOE-D Buff Company has specialized in Sisal—constantly experimenting and testing ways to give you faster-cutting, longer-lasting Sisal Buffs. Made of the finest quality imported sisal, specially woven and processed for guaranteed fray-proof performance . . . never a loose end to whip or scratch . . . always an even nap to hold compound and provide better color. For every Sisal Buff requirement, specify JOE-D, the original—and still America's finest—Bias Sisal Buff!

ATTENTION JOBBERS: Some choice territories still available. WRITE TODAY!

the JOE-D Buff Company

SANDWICH, ILLINOIS • TELEPHONE 2171

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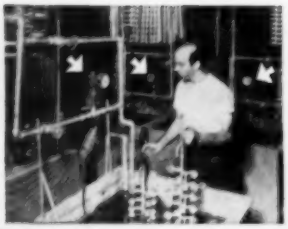
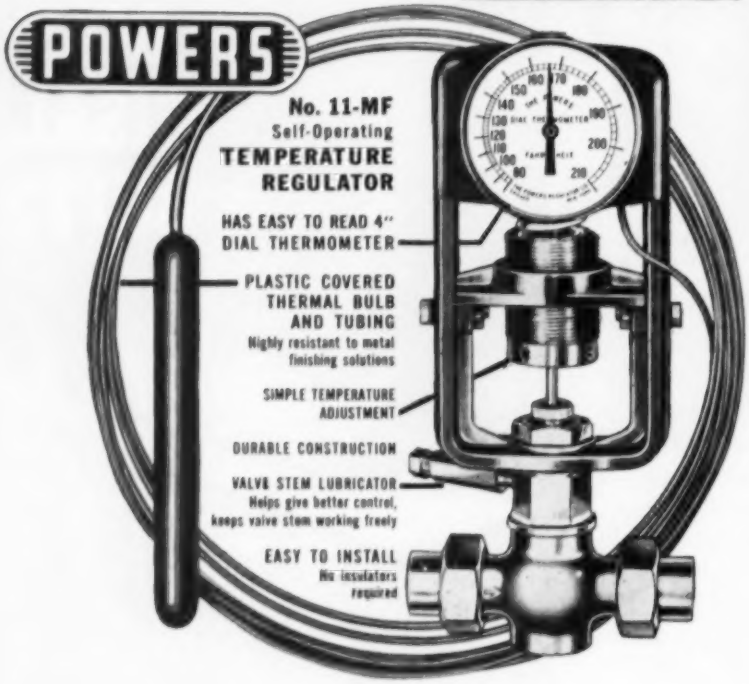
For Plating, Cleaning and Rinse Tanks





Simplest, Most Reliable Control Made

Holds Temperature at the Right Point

Savings Often Repay Its Cost 2 to 6 Times a Year

Why Powers No. 11-MF Regulator Gives Better Control and Lasts Longer—better TEMPERATURE Control results from powerful bellows and minimum of valve stem friction. Valve Stem Lubricator aids easy movement of valve stem without binding. Double ply metal used in Powers bellows outlasts ordinary single ply type. Greater durability of plastic covered bulb and tubing also helps prolong the life of the regulator.

Dial Thermometer indicates temperature of solution under control. It gives a visual check of the process and makes it easy to adjust regulator for different temperatures.

Eliminate "the human element" in temperature control with Powers automatic Regulators. They're simple, compact and dependable. They stop OVER-heating, prevent "boil-overs," waste of steam, water wasted by evaporation, burnt plated parts, rejects, decomposition of costly additives and loss of volatile ingredients from cleaning solutions.

Powers Nationwide Service and 24 Hour Delivery in the U.S.A. are important time and money saving advantages. Order a Powers No. 11-MF Regulator now. Call your supply firm or write us direct for Bulletin 330 and prices. (e43)

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

Over 60 years of Automatic Temperature and Humidity Control

Trade Literature

Zinc Applications

L—911. Zn vs Corrosion—"How Zinc Controls Corrosion," a 32-page illustrated booklet has just been published by the American Zinc Institute, New York, N. Y.

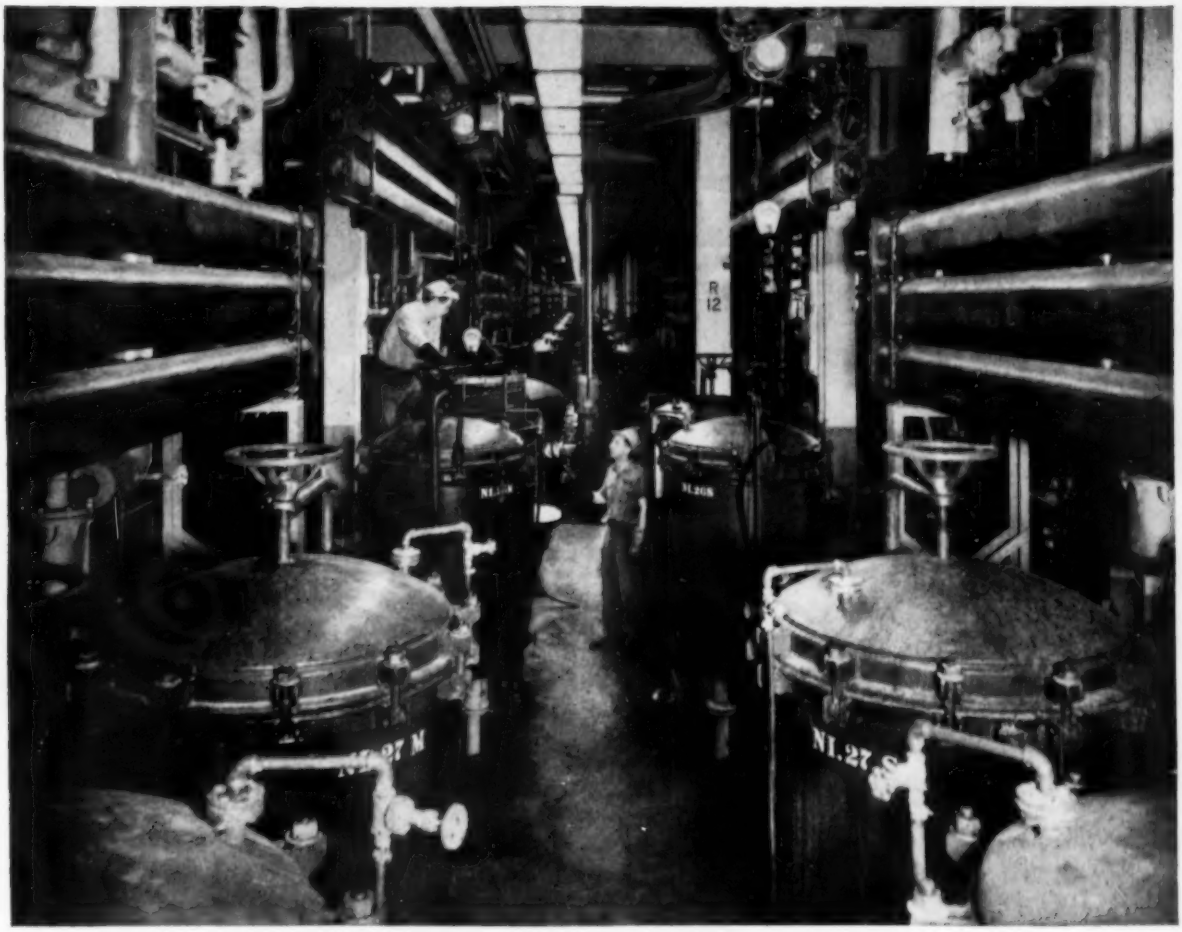
The book describes the many ways zinc lengthens the life of steel products, and reduces maintenance costs. Drawings, charts, and photographs together with brief comments present the corrosion control characteristics of zinc coatings, zinc pigments, and zinc anodes. An extensive selection of farm, industrial, marine and building applications of zinc is reviewed.

L—912. HI-VAC Equipment—New Catalog 551 describes in detail and illustrates High Vacuum Equipment Corporation's mass production and experimental type metallizing units. Detailed information is given on the special Planetary Interior Mechanism originated by High Vacuum Equipment Corporation which assures greatest production flexibility and economy. Also included is a description of the vacuum metallizing process, pointing out the versatility and time and money saving features of this modern mass production technique of metallic finishing.

L—913. Small Deaerating Heater—Graver Water Conditioning Co., New York, N. Y., is now offering a technical bulletin on its new, small size deaerating heater. This deaerating heater was specifically designed by Graver for use in small steam generating plants. Economy of operation, low initial cost and minimum space requirements are important features.

The bulletin describes in detail the design, operation and application of the heater. The heater is used in those smaller plants where heating of boiler feedwater and removal of corrosive gases are necessary.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 921.



48 Sparkler Horizontal Plate Filters in this installation

Why do the largest plating plants in the world Choose SPARKLER FILTERS?

The answer is simple, and obvious to plating engineers.

First — the cake on a Sparkler Horizontal plate filter will not crack or fall off with a variation in pressure or with a complete shut down of filtering. ***Second*** — dry cake disposal eliminates the sewer problem. ***Third*** — the quick-change plate assembly reduces the down time for cleaning each filter to a matter of minutes.

This is why many of the world's largest plating plants use Sparkler Filters exclusively.

Plating engineers can get full cooperation at Sparkler on any size installations.

SPARKLER MANUFACTURING CO., Mundelein, Ill.

Filtration engineering and manufacturing has been our exclusive business for over 30 years

Manufacturing plants in Canada, Holland, Italy, Australia

Service representatives in principal cities throughout the world

Sel-Rex

PRECIOUS METAL

"PLATEMATES"

Sel-Rex BRIGHT GOLD PROCESS

Add "Sales Appeal" to your products... without increasing your manufacturing cost! Here is the only Bright Gold Process that offers unlimited use —both decorative as well as functional. Produces a rich, mirror-bright surface that is *hard* and *corrosion resistant* without *scratch brushing* or *buffing*. Requires no special equipment and operates at room temperatures.

Sel-Rex "Silvrex" BRIGHT SILVER PROCESS

Another great Sel-Rex contribution to better, more economical precious metal plating. "Silvrex" is a crystal clear solution that produces a mirror-bright deposit without scratch-brushing and buffing. A one addition agent brightener that contains no sulphur or other impurities. The electro deposit is extremely ductile. Bath is simple to make up and to maintain. Wide range of current density.

Sel-Rex BRIGHT RHODIUM PROCESS

The swing is to rhodium... and first choice is the Sel-Rex Bright Rhodium Process! Our process produces a brilliant, fine grain deposit that combines hardness, high reflectivity and excellent resistance to corrosion. Sel-Rex Bright Rhodium is particularly ideal in the optical, jewelry, electrical and electronic industries.

Sel-Rex SILVER SOL-U-SALT

Only Sel-Rex Silver plating is a ONE-STEP process! Sol-U-Salt is a water soluble, crystalline cyanide salt containing 54% metallic silver. Add it directly to the bath — for either solution make-up or maintenance. Calculating, mixing and filtering are eliminated. Completely pure — reagent grade quality at technical grade price.

Try a trial order or write for complete literature.

Sel-Rex PRECIOUS METALS

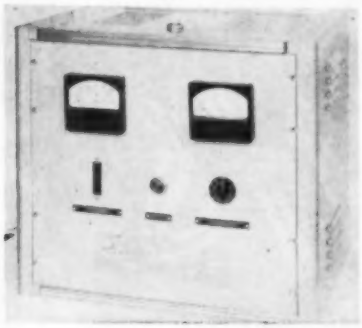
SEL-REX PRECIOUS METALS, INC.

229 MAIN STREET - BELLEVILLE 9, N. J.

Developers and manufacturers of bright precious metal plating processes.

Equipment & Supplies

Please use Reader Service Card for all items in this section



"Reactronic" Rates High!

E—914. Regulated D-C Power Supply Unit for Computer Applications—The development of a new lightweight, compact regulated d-c power supply unit, known as the Sel-Rex "Reactronic," designed specifically for computer and similar applications requiring close voltage regulation, has been announced by the Bart-Messing Corporation, of Belleville, N. J.

Features and advantages claimed for the Sel-Rex "Reactronic" include: automatic voltage regulation with magnetic amplifier control for smooth adjustment over the entire range; static regulation plus or minus 1 per cent from no load to full load; ripple voltage limitation of 1 volt—peak to peak; and maintenance free operation with nonwearing static components—no vacuum tubes or moving parts.

Equipped with time-tested and proven Selenium Rectifiers, the Sel-Rex "Reactronic" units are available from 4 to 300 volt capacities—at all current values from 1 amp.

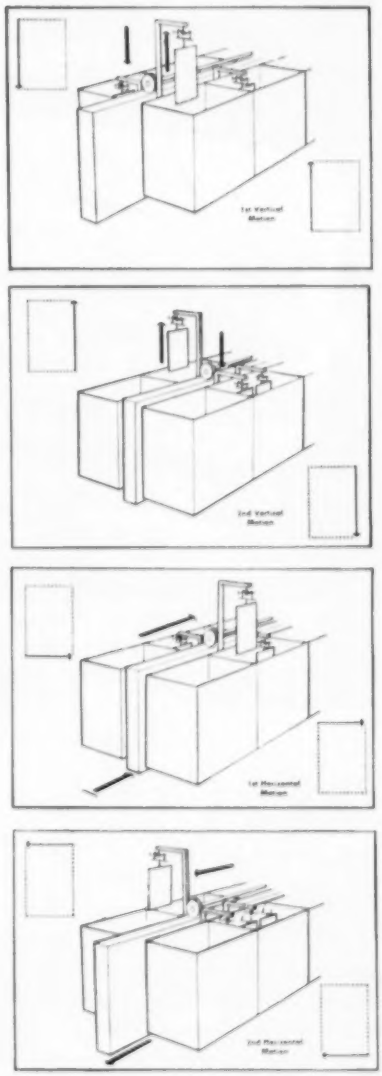
The manufacturer states that the special design of the Sel-Rex "Reactronic" permits modification to meet requirements of specific applications, such as those necessitating constant voltage output or variable constant current output, in sizes up to 50,000 amps.

E—915. For a Chromate film on Al_2.—The Chemical Corporation of Springfield, Mass. announces their new Luster-On Aluminum Sealer (222-M) which produces a chromate film on aluminum that provides excellent corrosion protection and can serve as a paint base. The new sealer replaces anodizing where hardness is not a prime factor; has salt spray resistance to 600 hours.

Luster-On Aluminum Sealer is easily applied in one dip at room temperatures; it adheres well and does not leach easily. It can be dyed in many attractive pastel colors. Meets government specification MIL-C-5541.

E—916. The Platocrat Has Simple, Versatile Design and is Automatic—Demonstrated for the first time at the 1955 Industrial Finishing Exposition, Wagner Brothers' new fully automatic plating mechanism, the Platocrat, was enthusiastically acclaimed by many viewers for its efficient, trouble-free design and versatile operation.

Among the Platocrat's unique features are: (1) a replaceable plating tank which enables the plater to change from cadmium to zinc in minutes, without the usual time-consuming tank cleaning operations. One tank is simply pulled aside and replaced with a spare tank. (2) The plating tank is electrically isolated from the rest of the mechanism to eliminate the possibility of stray currents. (3) Three-point rail contact of work-carriers assures constant, dependable current flow. (4) A versatile cycle allows as many as seven stations in both the pre- and post-plating cycle. Tanks are sectionalized at the factory to particular needs. (5) Racks are 12 in x 6 in x 30 in, provide big parts carrying area for higher production.



The Platocrat in Action

E—917. Waste Disposal Problem Eliminated—Since the disposal of chromic acid wastes in the anodizing industry is of major importance because of the legislation now adopted by many of the 48 states, Enthone, Inc., New Haven, Conn., manufacturers of chemical products for the metal finishing industry, has announced Deoxidizing Compound 89, a nonchromic acid containing material for stripping all types of anodic coatings from aluminum parts and racks. Deoxidizing Compound 89 is alkaline in nature and is used in water solution at room temperature for removing these anodic coatings by immersion only. Average coatings are removed in a few seconds. The compound contains no ingredients which make waste disposal a problem. Literature is available.

E—918. New Sizes in "Pebs"—Crown Pebs—the triangular shaped, ceramic, barrel tumbling media—are now available in a new smaller size, according to Crown Rheostat & Supply Co., Chicago, Ill.

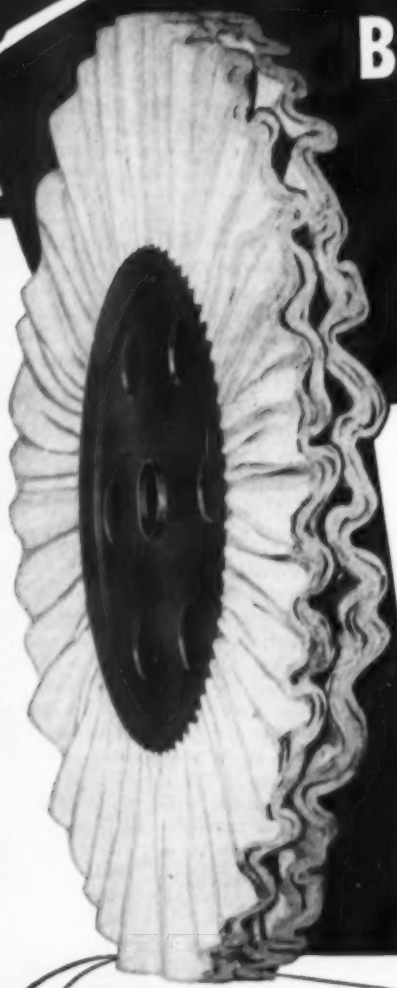
This new small-sized Peb considerably extends the range of usefulness to which Pebs may be applied. Using the new smaller size, fine finishing work can be more easily accomplished. By selecting the proper size, the "lodgement" hazard, encountered when conventional random shaped natural or synthetic stone chips lodge in holes and slots, is eliminated. This also eliminates the necessity for an extra operation to remove the lodged material.

The tough wear resisting ceramic used in the manufacture of Pebs insures a service life several times longer than either natural stones or aluminum oxide type of tumbling chips. Because of their uniform size and shape, Pebs can be quickly and easily screened to separate one size from another, or to separate them from the work being processed.

Crown's Midgets

New SCHAFFNER BIAS buffs

give more mileage . . .



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This new SUNBEAM TOASTER is "Automatic Beyond Belief" . . . it's faster . . . saves a housewife's time. It minimizes her efforts. She just drops the slices in the slots and lets the Sunbeam take over.

The idea of Automatic Operation has its place, too, in the finishing production line . . . as at Sunbeam where they use the well-known spray buffing compound, Lea Liquabrade, in an automatic spray buffing step on copper plated steel before bright nickel plating. Using Liquabrade increases buff life and saves compound by eliminating nubbins. Production is faster and cleaner. Cleaning costs are reduced because emulsifying properties of Liquabrade binders simplify cleaning procedures.

Lea Liquabrade is manufactured with high quality ingredients. Uniformity of binders and abrasive grain sizes for all grades are closely controlled by our laboratory. Using the Lea Liquabrade Method of Spray Buffing, in place of bar buffing compound, will give you maximum savings and a better finish.

If you're already set up for liquid spray buffing, we'll be glad to send you working samples of Lea Liquabrade. Just tell us what your finishing operations are and what metals are being buffed. Our laboratory will evaluate this data and recommend the proper Liquabrade buffing compounds for your use.

If you're using bar buffing compounds, write us in detail and we'll be glad to outline the savings to be made by shifting over to the Liquabrade Method of Spray Buffing.

Our objective is to help you save money on your metal finishing operations.

*Grades available for: Steel, Stainless Steel, Die Castings, Aluminum, Brass, Copper, Nickel Plate, Plastics

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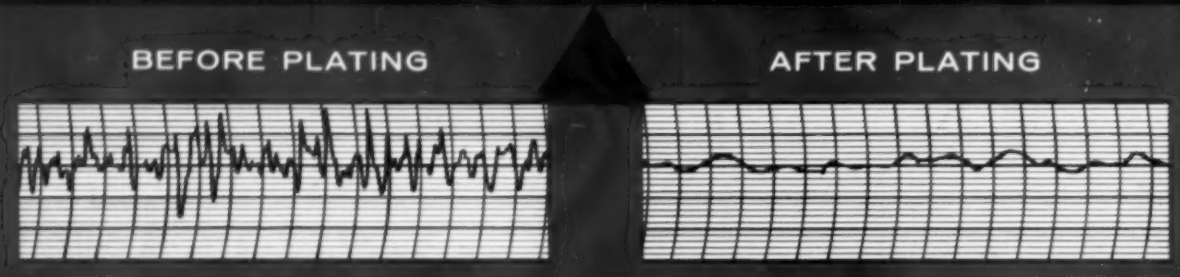
ANNOUNCING!

Lea-Ronal ACID COPPER PLATING PROCESS*

REMARKABLE LEVELING ACTION



• EXCEPTIONAL SPEED • OUTSTANDING ECONOMY
• COMPLETELY STABLE BRIGHTENERS

LEA-RONAL is now marketing a *new* Bright Acid Copper Process, using Copper Gleam addition agents, which in many production tests showed marked superiority over any former acid copper process. No new setup or special equipment is necessary to obtain the advantages of this Lea-Ronal Process. Conventional acid copper baths can be easily converted.

FEATURES INCLUDE:

1 . . . Exceptional Leveling Action, as evidenced by the surface analyzer tracing shown in the unretouched graph above. This means prefinishing operations can be greatly reduced or even eliminated.

2 . . . Economy in Buffing because the deposit has excellent buffability; coloring, where required, is easy and economical.

3 . . . Economy in Nickel because of the brightness and excellent leveling characteristics of the Lea-Ronal process. It is possible to use thinner nickel deposits. It is also practicable to substitute the Lea-Ronal Acid Copper Processes for nickel if leveling is the only requirement.

4 . . . Economy through Stability because the Lea-Ronal Brighteners are completely stable even at higher temperatures. No brightener breakdown takes place, hence fewer carbon treatments.

5 . . . Economy in Time because it is possible to operate at elevated temperatures without brightener breakdown; higher current densities and rates of deposits can be obtained.

If you are operating Acid Copper Plating Baths, why not investigate the merits of the Lea-Ronal Acid Copper Plating Process. Full details will be sent on request.

*patents pending.

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REPORTS from all over

. . . stripped, cleaned and degreased

(This section is especially compiled for the readers of PLATING; here the world in which we work and operate is stripped of its veneer, cleansed of its distortions and carefully degreased of superfluities).

Becco Chemical Div. of Tool Machine for more than a year has been quietly building a big hydrogen peroxide plant at Buffalo. It will use the new low-cost nonelectrolytic process. Cost, 2 million dollars.

In August, the patent office started hiring the technical personnel it needs to cut down the immense backlog of patent applications. Not much improvement in this situation is forecast, nevertheless.

In many sections (get a local ruling) the way plant machinery is mounted may cost extra taxes: a machine that is not lagged or bolted to the floor is taxed as personal property and therefore comes under accelerated depreciation provisions. In some cases, machines lagged to the floor are considered part of real estate and taxed as such.

Quotations on all metals quoted:	
ALUMINUM—(99 per cent pure plus ingot)	23.200
ANTIMONY—Five tons or more but less than carload	31.970
Bulk	28.500
In cases (Port Laredo)	29.000
CADMIUM—Producers' quotation	170.000
Producers' and platers' quotation	170.000
Platers' quotation	170.000
COPPER—Electrolytic, domestic	35.700
Electrolytic, export	36.339
GOLD—(per ounce U. S. price)	$35.000
LEAD—Common, New York	15.000
Common, St. Louis	14.800
MAGNESIUM—(ingot)	28.500
MERCURY—(per 76 lb flask)	$283.269
NICKEL—(F.O.B. Port Colborne U. S. duty included)	64.500
PLATINUM—(refined per oz)	$79.077
SILVER—New York, per/ounce	89.688
London, pence/oz	77.977
TIN—New York	93.625
New York, 99 per cent min	92.625
ZINC—Prime Western (E St. L.)	12.232
Prime Western (delivered)	12.732

METALS—Tin disease can be fought successfully by making sure that the composition of the tin is within a certain range before it is exposed to low temperatures. If ways could be found to keep tin in the gray form at ordinary or high temperatures, it might become as important as germanium and silicone in the electrical field . . . Poroloy, a new porous metal developed at *Cal Tech* is claimed by *Poroloy Equipt. Inc.*, Pacoima, Calif., to show promise for aviation uses such as high-temperature wall cooling, filtration and boundary layer control. This sintered-wire porous metal is made by positioning the wires mechanically in a predetermined relationship, then sintering them in a controlled atmosphere furnace. There is no bonding agent as such, and no powdered metals are used. It is available in large flat sheets, large seamless parts, long thin-walled tubes . . . *Claymont Steel Products*, Wilmington, Delaware, is advertising its Lectro-Clad nickel plated steel, electroplated by the patented Bart Process for economical protection against product contamination and discoloration. These steel products have all the strength of nickel-carbon steel yet are coated with a uniform heavy layer of metallic nickel (over 99 per cent pure). The protective nickel layer can be bent, welded or rolled without chipping, spalling or flaking.

FINISHES—Acid Hose made from "hypalon" chemical rubber resists strong oxidizing acids and other chemicals, according to *Du Pont & Co.* The new hose, said to have given four times service life of regular acid hose in a chromic acid operation is being introduced commercially after two and a half years of research . . . . Porcelain finish that looks like copper has been developed by *Pemco Corp.*, Baltimore. The maker says one firing of the new Coppertan finish, applied to a steel surface, gives surface that won't tarnish or scratch.

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A 165-53.	Electrodeposited Coatings of Cadmium on Steel
A 166-53 T.	Electrodeposited Coatings of Nickel and Chromium on Steel (Tentative)
B 141-45.	Electrodeposited Coatings of Nickel and Chromium on Copper and Copper-Base Alloys
B 142-53.	Electrodeposited Coatings of Nickel and Chromium on Zinc and Zinc-Base Alloys
B 200-53 T.	Electrodeposited Coatings of Lead on Steel (Tentative)
B 201-49 T.	Chromate Finishes on Electrodeposited Zinc, Hot-Dipped Galvanized, and Zinc Die-Cast Surfaces (Tentative)

Methods of:

A 219-51 T.	Local Thickness of Electrodeposited Coatings, Test for (Tentative)
B 117-49 T.	Salt Spray (Fog) Testing (Tentative)

Recommended Practices for:

B 177-49.	Chromium Plating on Steel for Engineering Use
B 183-49.	Low-Carbon Steel for Electroplating, Preparation of
B 242-53.	High-Carbon Steel for Electroplating, Preparation of
B 252-53.	Zinc-Base Die Castings for Electroplating, Preparation of
B 253-53.	Aluminum Alloys, Preparation of and Electroplating on
B 254-53.	Stainless Steel, Preparation of and Electroplating on
B 281-53 T.	Copper and Copper-Base Alloys for Electroplating, Preparation of (Tentative)

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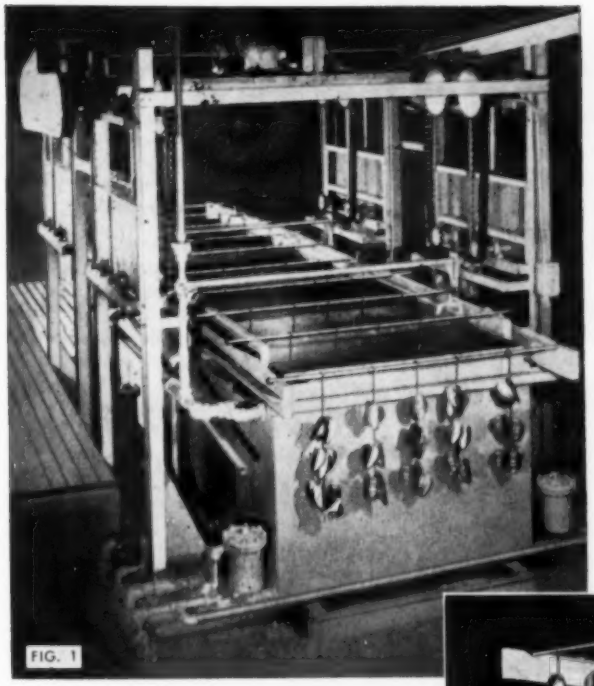


FIG. 1

NEW Automatic TRANSFER MACHINE for Pre-Plate Processing

One unit saves labor of 3 to 6 men.

Extremely flexible—different metals such as steel, brass and even die casting can be processed with the same set-up.

Shops that have BELKE Automatic Transfer Machines use them for most of their work.

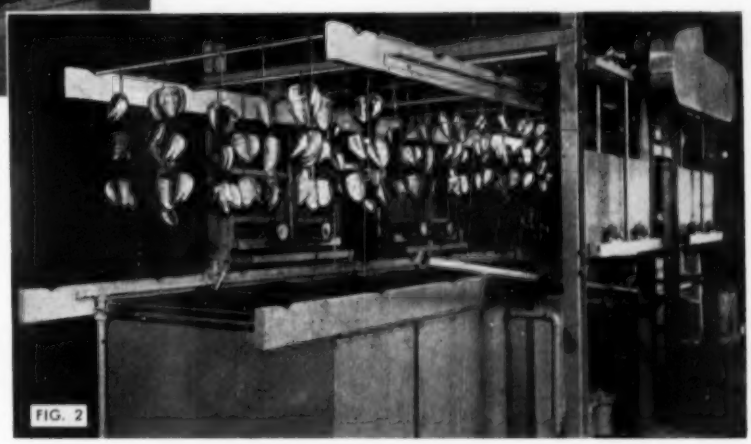


FIG. 2

Fig. 1. Loading End. Loaded racks are hung on rod placed in saddles on transfer frame. At end of each processing period the machine automatically lifts all rods and advances each one tank in the processing cycle.

Fig. 2. Delivery End. Picture shows transfer frame elevated in the transfer operation. When the frame comes down the last rod, which carries parts from the last tank in the processing cycle, will be placed in the unloading saddles on the frame which extends beyond the last tank.

Features

- Affords practically any required cycle for plating, painting, etching, etc.
- Flexible. Easily adjusted to "skip" tanks for processing articles of different basic metals without changing solution.
- Automatic Timing. Easily set for any processing period from 10 seconds to 20 minutes.
- Uniform Processing. The automatic timer doesn't forget—is not called away. Spoilage is avoided.
- Helps Foreman maintain full production. At a glance he can see partially loaded rods or empty saddles—then locate the cause.
- Available with conveyor-equipped plating tank to which processed work is automatically transferred.

The BELKE Automatic Transfer Machine stops the backaches and high labor costs of processing parts for plating.

The machine automatically lifts and transfers work from tank to tank through the entire pre-plating cycle such as electrocleaning, tepid running rinse, anodic electroclean, cold running rinse, acid bath, cold running rinse, cyanide bath, cold running rinse. Practically any cycle can be had.

The Transfer Unit can be adjusted to "skip" tanks as desired for processing articles of different metals such as steel, brass and die castings. This flexibility makes practical automatic processing of a great range of varied work.

For further labor-saving, a conveyor-equipped plating tank can be furnished with the BELKE Transfer Unit. The Transfer Unit automatically transfers processed work to the conveyor and the work is completely plated while moving through the plating tank.

Send for literature or see your BELKE Service Engineer.

Belke Manufacturing Company, 947 N. Cicero Ave., Chicago 51, Ill.

EVERYTHING FOR PLATING PLANTS

Equipment & Supplies

E—919. Quick Sticking Tape—A new pressure-sensitive general purpose paper tape with a quick-sticking adhesive has been developed to facilitate industrial taping operations of many kinds.

Field testing indicates this tape will save application time on such jobs as masking for protection and color separation; holding small parts in transit; sealing containers; and tabbing, repairing and reinforcing packages.

The new tape was specifically designed by its manufacturer, Behr-Manning Division of Norton Company, Troy, N. Y., to unwind easily from the roll and adhere readily to complex contours as well as flats. It has a flexible crepe paper backing resistant to heat, moisture and stains. Made thin to prevent paint build-up, it is strong and will resist breaking off in use. Once applied, the tape clings firmly in place without lifting or curling back; when removed, it comes off cleanly leaving no residue.

Fast and Efficient

Designated as No. 109 Behr-cat, the tape has an adhesive strength of 35 ounces and a tensile strength of 20 lb/in of width. It has an elongation of 12 per cent and withstands temperatures of 250 F. It is available in 60-yd boxed rolls in standard widths from ¼ in to 3 in. Other widths may be supplied on order.

E—920. Mg Protector—A primer for magnesium has been announced by the Stanley Chemical Company, East Berlin, Conn. Developed after two years of research in the company's laboratories, and designated as 40X-675, the primer can be sprayed or dipped and has fast-drying characteristics which speed production.

Designed to check electrolytic decomposition in assemblies where magnesium is joined to less active metal, the new primer also resists the solvent action of hydraulic fluids in aircraft. It can be applied directly either to untreated or to chemically treated magnesium.

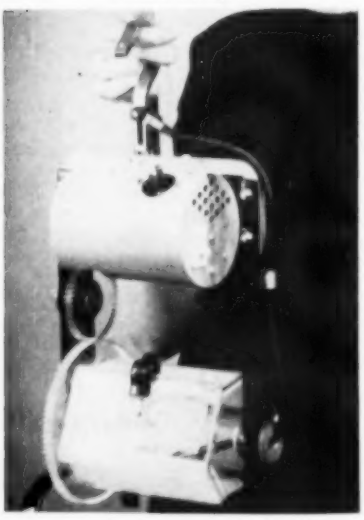
A film thickness of 1½ mils provides long lasting salt spray resistance. For maximum all-round effectiveness with the new primer, Stanley recommends formulated vinyl topcoats over 40X-675.

E—921. Midget-Size Plating Barrel—This barrel is so small that it can be picked up by one finger. Cylinder dimensions are only 4 x 6 inches, accommodating about 2½ pounds or ½ pint. This new barrel handles as easily as a plating rack and is particularly adaptable to still plating.

Lazo calls this new model the "Minim" because it takes a load about the size of a single handful. No basket is used.

A single hook on the Minim, similar to a plating rack, makes it as practical a unit as the large size barrel. The manufacturer states that the standard 1/16 inch perforations of the Lazo Minim, being extremely close together, plus the thin diameter of the Lucite, delivers as high a quality and plating speed as any barrel having a 3/16 inch perforation.

Lazo's Midget



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NICKEL ANODES in all standard shapes and formulas.

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BRIGHT NICKEL produces bright deposits without coloring and buffing.

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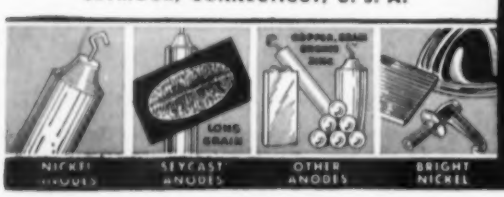

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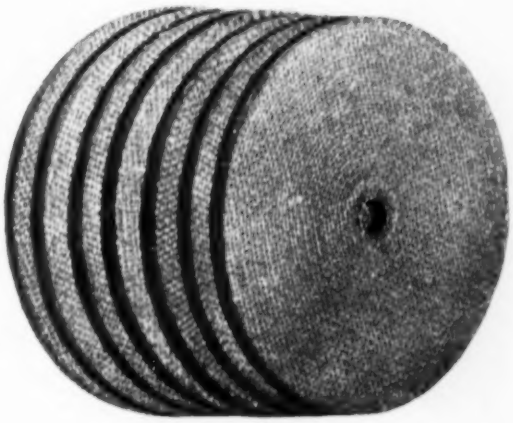

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Equipment & Supplies

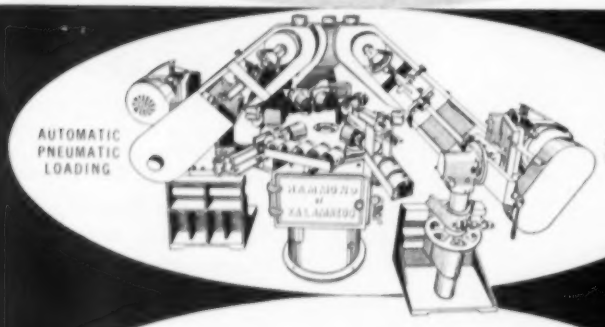
E—922. New Barrel Deburring Compound Announced—Oakite FM 184, a mildly acidic compound for barrel deburring, descaling, and derusting, has recently been introduced by Oakite Products, Inc., manufacturers of metal cleaning and finishing materials.

The new material was specifically designed by the Oakite laboratories to replace raw acids in barrel operations, where alkaline materials and abrasives are impractical because of time limitations. It is also designed to improve color of steel after alkaline deburring; to remove heat scale from steel; and to brighten brass, either with or without the use of abrasive media.

Oakite FM 184 is said to have good foaming properties at the recommended concentrations of 1 to 3 ounces to the gallon of water. It may be added dry to the burnishing barrel.

E—923. Sn-Ni Plating Alloy—A rack of timing mechanism tubes is lifted from still tank by Louis Morin, sales engineer and chief plater for the Century Plating Company, White Plains, N. Y. Morin—who pioneered use of tin-nickel plate in this country after learning of its development by the Tin Research Institute in England—lauds use of the alloy for plating wherever corrosion, friction or hard wear of parts is a factor. Morin says tin-nickel alloy's versatility has been proved by use in plating products from the smallest of parts for timing mechanisms to 180-pound valves for the chemical industry.

Hammond of KALAMAZOO AUTOMATION



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E—924. Tapered Lucite Porto-Plater—Uniform plating of small odd-lot quantities ranging from a small handful to full capacity is provided by new Porto-Platers with tapered Lucite Cylinders announced by Belke Manufacturing Company, Chicago, Ill.

The tapered cylinder concentrates the small load around the ball contact thereby avoiding the uneven deposit and partial plating that results when a small load is scattered the full length of conventional cylinders.

The new odd-lot Portó-Plater has "V" notched contacts that fit at any point on the cathode rod.

Self-contained motor drive with reversing switch turns cylinder in either direction and holds it in position for loading and unloading.

The cylinder of high temperature lucite is free of ribs, tie rods and crevices. Attached lucite cover locks cannot be misplaced or dropped into the tank.

The ball contact is mounted on a one-piece dangler cable. Geared head motor for 115 v, 60 c, 1 ph, with plug connection.

Cylinder at large end is 6 inches i.d. and 12 inches long. Plating capacity, 1/8 peck; weight empty 28 lbs.

E—925. Two New Organic Brighteners—Two new organic addition agents for use in acid copper sulfate electrolytes are now available from Westinghouse Electric Corporation's Electroplating Projects Department.

E—926. Round Lead Anodes—Round lead anodes for chromium plating were one of the new products introduced by Heil Process Equipment Corporation, manufacturer of corrosion-resistant equipment, at the recent Industrial Finishing Exposition in Cleveland.

The anodes are supplied in four standard sizes—Standard, Medium, Heavy, and Super R. The availability for the first time of four sizes allows the use of the best diameter size for each specific chrome plating requirement.

Six styles of knife-edge hooks and two heavy-duty flat face hooks are available. Flat bent copper hooks can also be furnished to exact specifications.

This wide range of standard lead coated copper alloy hooks provides a hook to exactly fit all bus bar and solution level requirements.

For additional hook protection, a vinyl plastic hook coating is furnished as an optional feature.

The anodes are supplied of virgin lead and tin materials specially alloyed for use in all chrome solutions. Other alloys can be furnished. The round anode design assures better current distribution, affording faster plating and better chrome coverage.

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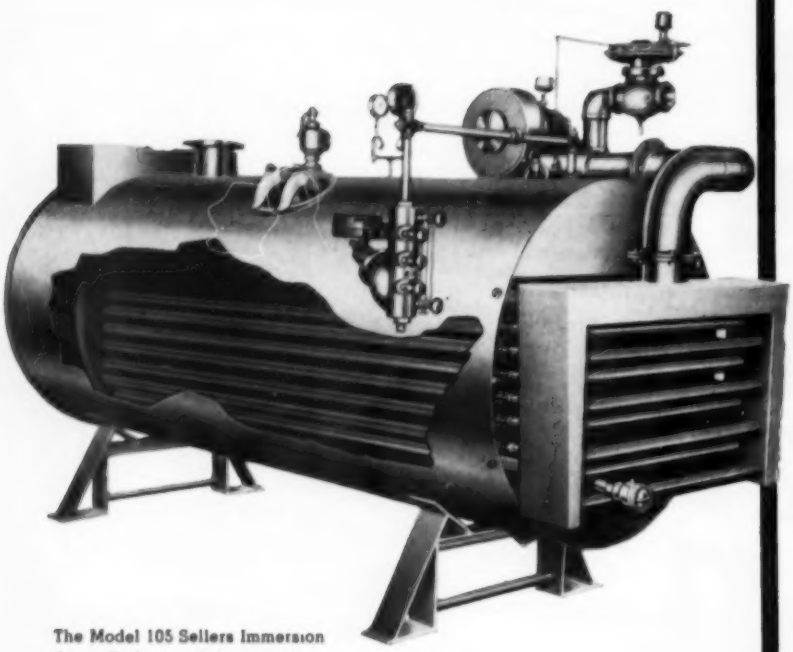

The Model 105 Sellers Immersion Steam Boiler is another steam boiler designed and built with totally submerged and horizontally located firing tubes.

This system of firing permits all gas to be burned inside the submerged tubes — and therefore *inside the water.*

Every tube is an individual combustion chamber with its own burner — *completely surrounded by water.* This is the most efficient method ever devised.

And this system permits "spreading out the fire" — to put every square foot of heating surface to work, increasing life, internal circulation, and operating efficiency.

The Sellers Model 105 Immersion Steam Boiler is only one of a complete line — all are companion boilers to the famous Sellers Model 46. Investigate this line — there is one to fit your requirements.

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- ***MINIMUM SCALE PROBLEM***
  Intermittent firing of the boiler brings about alternate expansion and contraction of the firing tubes which loosens scale which might form on the tubes. This scale drops to the bottom of the shell out of the firing zone and cannot bake on to the firing tubes. Clean out openings are provided.
- ***CONTINUED HIGH EFFICIENCY***
  As long as firing tubes are kept clean, original high efficiency is economically maintained.
- ***NO WATERLINE CORROSION***
  With all firing tubes totally submerged, there is no corrosion at the waterline—where tubes normally fail. In Sellers immersion type steam boilers, there can be no waterline corrosion.
- ***MORE EFFECTIVE INSULATION***
  More effective insulation is possible because the insulation is against heat loss from low temperature steam and water instead of a high temperature combustion chamber.
- ***FASTER STEAMING AND DRYER STEAM***
  Rapid steaming and dry steam takes place because of the large surface area of the water. All surface water is heated first since the firing tubes are located close to the water line.

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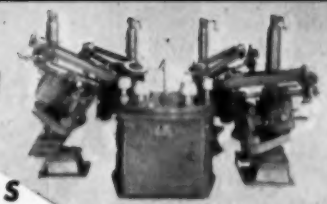

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E—927. New Package—The new Seymour package offers several unique advantages .Since the cartons are only 14 inches square and 12 inches high, they are easily stacked in a small fraction of the space required for the big, wooden framed glass jugs.

A major feature of the new package, however, lies in its throwaway features. The older carboy packing system required that users return containers to the supplier. This of course created a certain amount of confusion and was a definite inconvenience.

E—928. Carbonate Remover—A new carbonate remover, Wes-X 150, has been developed by the Electroplating Projects Department of Westinghouse Electric Corporation for use in any proprietary alkaline cyanide plating process in which removal of carbonates is desirable. The new carbonate remover precipitates carbonates in exchange for cyanide ions. It also assists in the elimination of certain contaminants.

Representing a new approach to the control and maintenance of alkaline cyanide plating processes, the new carbonate remover can be used in conjunction with hydrated lime to maintain optimum concentrations of hydroxide and free cyanide without alkali metal cyanide or hydroxide additions. It is an ideal source of cyanide ions when complexing metal cyanides in both sodium and potassium types of plating solutions.

E—929. Perforated Metal Basket for Anodizing—Anodizing of small metal parts, such as screws, nuts, camera parts, etc. are easily handled in this new aluminum anodizing basket offered by Wiretex Mfg. Co. Inc., Bridgeport, Conn. Constructed of aluminum, welded and riveted, it features an adjustable cover to hold the correct amount of tension on the parts, depending on the load carried. It is 6¼ x 24 inches overall, with the aluminum handle and ½ inch threaded bar.

Holder

Article References

By
WILLIAM TUCKER

Most of the articles listed here may be obtained by writing to the publication. Addresses are included for the reader's convenience.

88. ALUMINUM FINISHES

a. *A METHOD FOR THE ISOLATION OF SURFACE FILMS FROM ALUMINUM ALLOYS AND THE MECHANISM OF THE REACTIONS INVOLVED*
M. J. Prior and D. S. Keir
Journal of the Electrochemical Society, V. 102, No. 7, pp. 370–381

89. CHROMIUM

a. *ELECTROLESS CHROMIUM*
Harry J. West
Metal Finishing, V. 53, No. 7, July 1955, pp. 62–63

90. CLEANING, DEGREASING AND PICKLING

a. *CLEANING AND FINISHING PRACTICE FOR PHOSPHATED ZINC COATED SHEETS*
W. E. McFee
Organic Finishing, V. 16, No. 7, pp. 11–13

91. CORROSION

a. *ON THE PASSIVITY OF IRON*
Karl Friedrich Bonhoeffer
Corrosion, V. 11, No. 7, pp. 32–36

b. *COATINGS: GOOD STRUCTURAL DESIGN AIDS BATTLE AGAINST CORROSION*
C. G. Munger
The Iron Age, July 14, 1955, V. 176, No. 2, pp. 108–111.

c. *CORROSION RESISTANT ALLOYS PLAY KEY PART IN PICKLING*
Iron Age, July 7, 1955, pp. 94–96

d. *DISSOLUTION OF METALS IN AQUEOUS ACID SOLUTIONS*
A. C. MaKrides, N. M. Komodromos and Norman Hackerman
Journal of the Electrochemical Society, V. 102, No. 7, pp. 363–369

92. ELECTROPLATING GENERAL

a. *INSTITUTE OF METAL FINISHING ANNUAL CONFERENCE AT TORQUAY, MAY 1955*
Electroplating and Modern Finishing, V. 8, No. 6, June 1955, pp. 229–238

93. NICKEL

a. *THE PREVENTION OF CRACKING IN NICKEL DEPOSITS*
T. E. Such
Products Finishing, July 1955, V. 19, No. 10, pp. 62–68. (A resume by C. Fred Gurnham.)

b. *ELECTRODEPOSITION OF NICKEL FROM FLUOBORATE SOLUTIONS*
C. B. F. Young and William Strobach
Metal Finishing, V. 53, No. 7, July 1955, pp. 44–52

94. SURFACE

a. *ELECTROMACHINING AND SUPER FINISHING AS A PRODUCTION TOOL II. THE FINISHING OF HIGHLY STRESSED PARTS*
Electroplating and Modern Finishing, V. 8, No. 7, July 1955, pp. 245–249

95. TESTING

a. *GET BETTER ADHESION BY CHECKING PLATING SOLUTIONS SPECTROGRAPHICALLY*
A. M. Howard
Iron Age, July 7, 1955, pp. 98-101

b. *pH FOR THE ELECTROPLATER*
J. B. Mohler
Products Finishing, July 1955, V. 19, No. 10, pp. 32–46

c. *THE SLOT CELL*
J. B. Mohler
Metal Finishing, V. 53, No. 7, July 1955, pp. 53–58

96. TIN

a. *BRIGHTENING AGENTS FOR THE TIN. II. SULFATE—SULFURIC ACID ELECTROLYTE*
C. A. Discher and F. C. Mathers
Journal of the Electrochemical Society, V. 102, No. 7, July 1955, p 387–389

97. TITANIUM

a. *ELECTRODEPOSITION OF TITANIUM*
A. E. Creech
Electroplating and Modern Finishing, V. 8, No. 7, July 1955, p. 253

***

Below are listed the addresses of publishers where the reader may send for article references.

Corrosion
M & M Bldg.
Houston 2, Texas

Iron Age
56th and Chestnut Sts.
Philadelphia, Pa.

Journal of Electrochemical Society
216 W. 102nd St.
New York, N. Y.

Metal Finishing
381 Broadway
Westwood, N. J.

Organic Finishing
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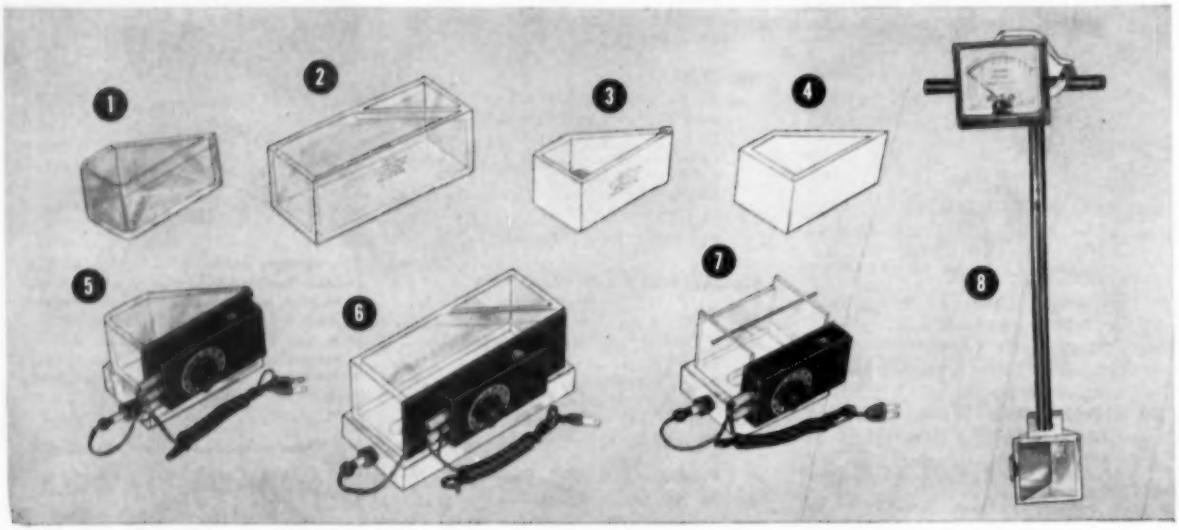

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7. Lucite "WT" Duplicell with quartz heater and built-in thermostatic control. For making duplicate bright nickel deposits preparatory to testing chromium baths for optimum catalyst ratio. (Plain Duplicell, without heater and thermostat, is also available.)
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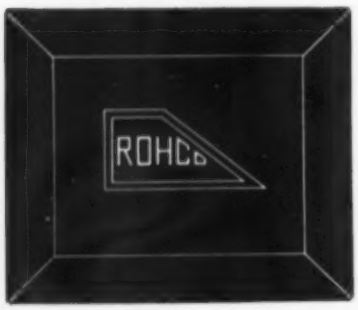

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"THE HULL CELL TEST MAKES PLATING BEST!"

Patent Abstracts

DR. D. GARDNER FOULKE

Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co.
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,700,646, January 25, 1955—Electroplating Zinc-Copper Alloys—A. Chester, assignor to Poor & Co., Chicago, Ill.

This invention refers to addition agents to white brass solutions, although the claims are not limited to solutions yielding deposits with the normal white brass Zn:Cu ratio. The addition agent claimed is dithiobiuret, 0.5 to 12 g/l mentioned. Other claims mention the use of aldonate and an oxyaldehyde-amine condensation compound.

12 claims.

—AES—

No. 2,700,647, January 25, 1955—Alloy—C. Welcher, assignor to Butler Engineering Co., New Orleans, La.

An electrolytic water correction device (anode) is claimed consisting of mostly zinc, along with aluminum, 0.25–7 per cent; magnesium, 0.05–0.5 per cent, and 0.01 to 1 per cent of a polyvalent ion such as vanadium, molybdenum and mixtures thereof.

8 claims.

—AES—

No. 2,700,654, January 25, 1955—Cleaning Solution and Method—E. Holman, assignor to Turco Products, Inc., Los Angeles, Calif.

This solution is particularly good for removing complex carbonaceous deposits found in airplane oil coolers and the like. The formula is given as:

	Per cent by weight Approximately
Ethylene diamine	12
Water	4
Neutral coal tar oil	68
Oleic acid	6
Pine oil	10

2 claims.

—AES—

No. 2,701,186, February 1, 1955—Method of Making Photoengraving Plate—R. Hedrich and D. O'Brien, assignors to The Wire Coating & Mfg. Co., Cleveland, Ohio.

The method is claimed to reduce by etching solution. Refers particularly to the bimetallic plates of magnesium coated with zinc. The etching solution contains aluminum ions which form a hydrosol electrostatically attracted to the interface, it is claimed. The precipitate creates a bank to protect the relieved portions of the plate.

11 claims.

—AES—

No. 2,701,238, February 1, 1955—Silver Protecting Cloth—A. Renold, assignor to Bates Manufacturing Company, Maine.

A composition for treating textiles to protect silver from tarnishing is described which consists of a silver compound reactive to sulfide and a solid filler grinding aid (starches) dispersed in a drying oil.

26 claims.

DO YOU NEED ANSWERS TO THESE QUESTIONS?

1 How can I electroclean steel at lower cost?

2 How can I find a brass cleaner that gives better protection against tarnishing?

3 How can I reduce rejects due to faulty electrocleaning of zinc die castings?

***Answer* 1** Following an Oakite recommendation, one plater made a small change in his steel-cleaning cycle and soon had two tankfuls of cleaning solution doing the work of three—and the plate adhesion was improved. *See booklet offered below.*

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- ☐ "What's NEW for electrocleaning brass and other copper alloys"
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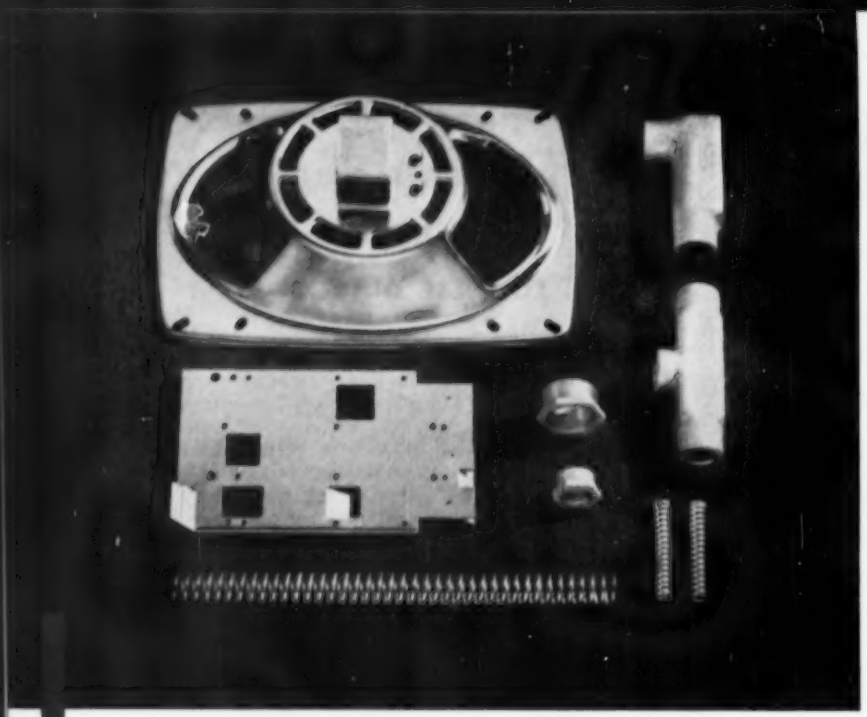

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Udylite Bry-Cad has other advantages such as: High cathode efficiency, simplicity of operation and control, attractive finish with less tendency to finger mark, a self-lubricating metal and good resistance to mild alkalies. Bry-Cad is easily adapted to plating in barrels, hand operated tanks, semi-automatics or full automatic machines.

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Mail Box

Dr. E. B. Saubestre June 14, 1955

Sylvania Electric Products, Inc.
New York, N. Y.

Dear Ed:

I want to thank you for the very detailed and careful review of the Handbook which you prepared for the June issue of PLATING. We are in complete agreement on most every point. The exceptions are items which involve policy or opinions with respect to the scope of parts in the book, and it is natural that there would not be complete agreement on these. However, I feel that opinions of readers with respect to such items is of great value, especially when it comes to revising for a later edition.

With the latter thought in mind, I would appreciate further clarification with respect to the following points.

Chapter 1: You state that Table 10 is not as well handled as it could have been. Do you have in mind that factors should be included for the ingredients of all plating baths other than those given? It was with some hesitancy that we included these data in the first place, but they were not readily available elsewhere and we had worked them out for our own requirements. Possibly we erred in not including data on the other baths on the assumption that the factors were pretty well known. This, of course, is no excuse.

Chapter 2: You state "it is too brief to realize its maximum potential and it appears to be aimed more to the specification writer than the plater." The latter is true since the plater has little to say about the design, if anything. In the large organizations it is usually up to the plating engineers to reconcile their views and requirements with the designer's ideas. If you would care to express your opinion more specifically as to what further would be of value, I would appreciate it.

Chapter 5: The statement was made that the use of sequestering agents is under-played. It is not clear to me to what extent sequestering agents have a place in water requirements for plating. Please elaborate and oblige.

Chapter 6: Data on stripping appears to be meager, according to your statement. This is because we endeavored to limit stripping data to that which is normally used in production, as contrasted to that which is used in the analytical lab or in salvaging of a valuable old piece to be replated. I am not unsympathetic to your viewpoint, but would appreciate specific suggestions as to what might further be added within the classification of practical and economical procedures.

The same philosophy governs the choice of plating baths, namely, that unless they were used in substantial gallonage in production, we should not discuss them. Chapter 6 was delivered to the printer in the summer of 1952 and since then some baths have gained prominence but were not included. In the interest of completeness, however, I would appreciate your recommendations as to what additional baths or processes should have been included.

Chapter 8: If this chapter is too restricted because of its emphasis of copper and/or nickel coatings for decorative use, will you please indicate what additionally, in your opinion, should be specifically covered.

Chapter 9: We purposely limited this chapter to volumetric methods of analysis. These methods are most readily available to the plater with limited training. We felt that it would be premature to include detailed methods of analysis for trace impurities, especially since these data were being further developed with respect to waste solutions, etc. Even if they were all available, there was a question in our mind as to the advisability of lengthening the book with respect to these details. In my opinion it is difficult to justify lengthening the chapter in this respect. However, in view of the philosophy expressed, if you feel that it should be done, I would like you to advise me.

With respect to specific comments on other chapters, I have referred them to the contributors for consideration.

Again let me thank you for the service you have done us. I am sure that all of the contributors will appreciate your constructive criticisms and suggestions.

If you plan to be at the AES convention, I trust that we may have a chat regarding these matters.

Best regards.

Sincerely,
GRAHAM, CROWLEY AND ASSOCIATES, INC.
A. Kenneth Graham
President

AUGUST 4, 1955

Dear Sirs:

This letter has a two-fold purpose. One is to acknowledge your fine support of the American Cancer Society's 1955 Crusade. The second is to share with you the good news that present returns indicate that we will not only realize, but will exceed our goal.

There are a number of factors to account for this, but most heartening and in my mind of major importance, is one for which you are largely responsible. The American people, through media that has a tremendous impact on thinking, are now alerted as never before to cancer—to its danger signals, to the increasing possibility of cure, to the potentials of research in ultimately conquering it.

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The same benefits Marchant Calculators, Inc., enjoy from the installation of a Udylite automatic plating machine can be yours—and for only a modest capital investment.

Better process control, reduction in operating and maintenance costs and improved work quality are the result of Marchant's installation of a Udylite Junior Full Automatic. In addition, they are now experiencing better ventilation, better and safer working conditions, manufacturing control with built-in instrumentation, greatly reduced materials handling and a minimum of rejects.

When the time came to install new plating facilities for their expanding business, Marchant naturally turned to Udylite. After a study of the Marchant problem Udylite engineers recommended the Udylite Junior with an automatic load and unload conveyor for the cadmium plating to fine tolerances of the many parts of the Marchant Calculator.

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Dear Mr. Burnley:

Thank you for stopping by a few days ago to discuss the faulty chart which was published in your June, 1955, issue. I'm sorry that Mr. Luce was not available at the time of your visit to discuss the matter with you personally, but he has written as follows, which you may quote if you wish.

"We reviewed with considerable interest the colorful chart outlining the corrosion resistance of various materials to a variety of corrosives which appeared on page 613 of the June, 1955 issue of PLATING. While the appearance of the chart was excellent and does credit to the magazine, certain of the data contained therein are incorrect. This is particularly the case with the metals and alloys where the data are sufficiently incorrect in a few instances as to reflect detrimentally on those materials. We particularly point to the Durimet 20 alloy where at least half the data are in the questionable category. In such instances it may very well be advantageous to make corrections for the benefit of PLATING's readers.

"One other point which may be worthy of consideration involves the particular corrosives selected in this chart. In many instances these are not common to the plating field and the value of the chart could certainly have been enhanced by a more suitable selection of corrosives. Because there is a definite need for a chart of this type, it might be well to consider making the necessary revisions in a subsequent issue."

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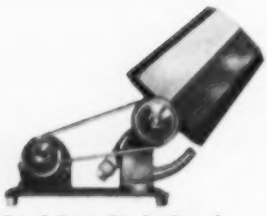

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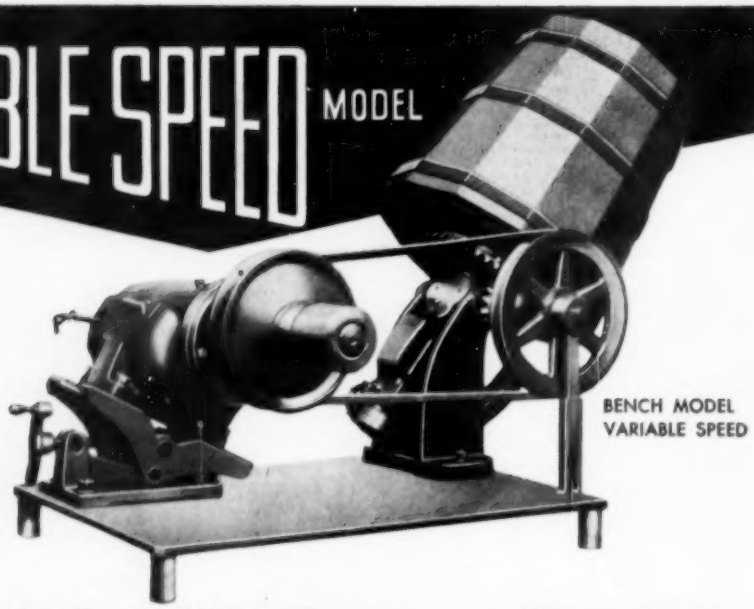

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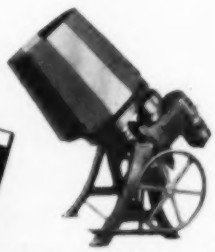

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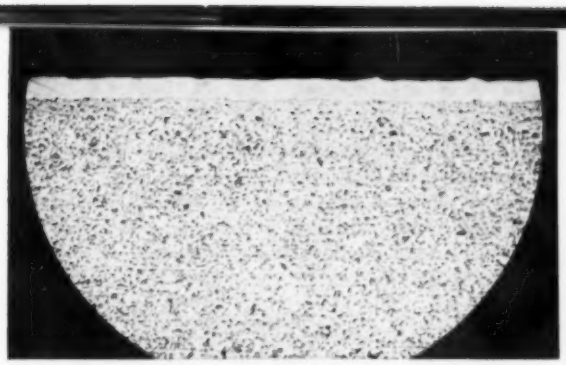


Figure 1
Steel surface processed in anodic epsom salt-sulfuric acid solution prior to nickel plating. (100X)

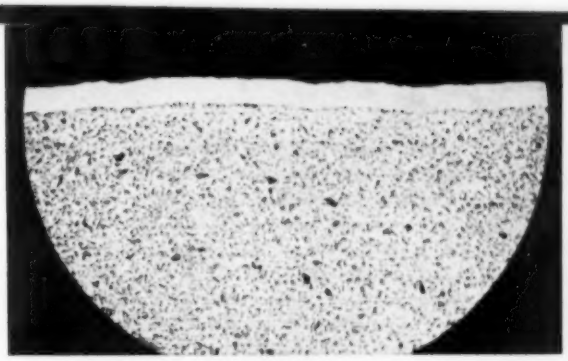


Figure 2a
Steel surface acid dipped in 10 per cent by volume muriatic acid before nickel plating. Line of demarcation of nickel and steel different from Figure 1. More dark stops or voids noted in Figure 2 (a). (100X)

THE ANODIC ETCH IN PREPARATION FOR PLATING*

F. G. BRUNE† and V. L. McENALLY JR.‡

ABSTRACT

The use of a sulfuric acid-epsom salt anodic etch solution in preparation of ferrous parts for plating is discussed. The successful application of this process to obtain good adhesion between the base metal and a nickel plated coating is reviewed. A concept is offered to help in understanding the mechanism by which the anodic etch assists in the preparation for plating. The unanswered questions emphasize the importance of AES Research Project No. 12, "The Cleaning and Preparation of Metals for Plating."

INTRODUCTION

The use of an anodic etch in the preparation of ferrous parts for electroplating has increased during the post-war period. As stated by Blum and Hogaboom[1] the purpose of this anodic treatment is to remove smut and to etch the surface in a manner and degree that will promote adhesion of subsequently deposited coatings.

The accepted practice in cleaning metal surfaces prior to plating is to have a "chemically" clean or "perfectly" clean surface. During the late '30's as the use of plated zinc base die castings increased, it appeared that a perfectly clean surface may be too "active" to handle in commercial practice. This led to the development of anodic cleaners that left a "film" on the surface until the copper was applied.[28,29,30] Also the use of oxide films on aluminum and phosphate films on steel prior to plating seem to indicate that the certain "films" on a metal surface in the preparation for plating are desirable.

The successful use of the 55° Baumé sulfuric acid etch in the nickel plating of steel bumpers[2] is additional proof that anodic treatments are important. The results obtained by plating ferrous parts prepared by electropolishing with the

Figure 2b
Cross-section at area where nickel has peeled during bend test. Note dark areas or voids that allowed further peeling of the coating. (100X)

Battelle Process[3] convinced the writer in the use of anodic process in the preparation for plating. These tests made during 1947–1949 were to evaluate the effect of electropolishing on low carbon steel parts that were nickel-chromium plated. The different methods of preparation and test conclusions are listed in Table I. Electropolishing improved the corrosion resistance as measured by the salt spray test and outdoor exposure. (Note: Pinner and Pierce[27] recently reported that the 55° Bé anodic etch improves corrosion resistance.) Electropolishing also provided good adhesion of the plated coating as measured by bend tests.

DISCUSSION

In 1953 the writers had to select a cleaning process that would assure good adhesion over low carbon steel. The adhesion of 0.003 inch of nickel, plated on a steel bar 11 inch x 1½ inches x ¼ inch, to be measured by bending the ¼ inch dimension about a 1 inch radius 180° and then reverse bending to its original flat form, no peeling or flaking of the nickel coating was allowable.

Various anodic sulfuric acid treatments[2,4,5,6,7,8,9,10] were considered for the above application. Most of the processes required high current densities in the range of 125 to 200 amp/sq ft. The parts to be processed were 100 square feet in size so that at 200 asf, both the power source and cooling capacity required were fairly large. These problems were discussed with W. H. Prine, the International Nickel Com-

*Presented at the Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

†Metal Finishing Engineer, Chrysler Jet Engine Plant.

‡Chief Metallurgist, Chrysler Jet Engine Plant.

pany, Inc., who recommended the consideration of a solution using sulfuric acid and epsom salt. Tests were conducted using the solution with satisfactory results, so that it was adopted to the process as follows:

1. Alkaline, high pressure spray washer
2. Anodic electroclean at 75 asf
3. Warm water rinse
4. Cold water rinse
5. Muriatic acid dip, 10 per cent by volume
6. Cold water rinse
7. Anodic etch, epsom salt-sulfuric acid at 50 asf
8. Cold water rinse
9. Nickel plate

Fig. 1 shows the nickel plate and steel surface processed in the anodic epsom salt-sulfuric acid solution. Fig. 2 shows the type of peeling of the nickel plate from the steel after a 10 per cent by volume muriatic acid treatment and bend test. It should be mentioned that the transfer time for handling the 100 sq ft plates from tank to tank was 2½ minutes minimum. This long time interval was used in test work in selecting the cleaning process.

The anodic etch solution is a 3-phase system as shown in Fig. 3 with an initial make-up on a weight basis being approximately 25 per cent water, 25 per cent sulfuric acid and 50 per cent epsom salt (magnesium sulfate). About 20 per cent of the tank volume was added as water and saturated with epsom salt. Then alternately add sulfuric acid and epsom salt until the solution is made up. After analysis, water can be added to adjust the level if required.

TEMPERATURE

The bath was operated from 50° F to 80° F. In this range a good etch and adhesion of the nickel is obtained. However, at the higher temperature, a rapid transfer from the etch tank through rinse and into the nickel tank is required. For this work up to 3 minutes transfer time was needed, so it was necessary to hold the etch temperature at a maximum of 60° F. However, it is known that other plants operate at temperatures as low as 30° F, which should minimize the depth of etch.

WATER

"Drag-in" of water should be held to a minimum since each addition of epsom salt to the bath supplies a considerable amount of water of hydration. In special cases, it may be necessary to add a different magnesium salt.

EPSOM SALT

The normal operation of the bath is to maintain the composition along the saturated solution line. The solid phases known are $Mg(SO_4)\cdot H_2(SO_4)\cdot 3H_2O$ and $Mg(SO_4)\cdot 3H_2(SO_4)$. Due to the presence of these double salts, the bath tends to self-regulation, but regular additions of sulfuric acid and epsom salt are required to maintain the concentration at saturation.

In the operation, the acid is checked daily and additions are made. The epsom salt is checked by analysis once a week and by a practical test, twice a week. The production control test consists of placing a known amount of salt in a test tube, filling with solution from the tank, cover with a stopper and shake. Then suspend the test tube in the tank overnight and check the amount of salt dissolved the next day.

When the etch tank is operated, the usage is dependent upon drag-out. This operation required an additional 100 pounds of epsom salt for each 350 pounds of sulfuric acid used. At this temperature range, it takes about 40 oz/gal of epsom salt to saturate the solution. The bath can be operated with less than a saturated solution, but with less satisfactory results; at a concentration less than 20 oz/gal, the results obtained are poor, and the bath is unsatisfactory at a range between 10 to 14 oz/gal. The best results are obtained when some solid is on the bottom of the tank indicating full saturation.

Table I
Comparison tests on steel headlight doors using different methods of preparation and 0.00125 inch plate

1. Polished with 180 and 240 grit belts cleaned in normal commercial automatic with anodic electroclean and mild sulfuric acid dip and plated.
2. As formed part electropolished in Battelle process 5 minutes, rinsed and plated.
3. As formed part electropolished in Battelle process 10 minutes, rinsed and plated.
4. As formed part, cleaned and then pickled in 10 per cent by volume muriatic acid for 10 minutes at room temperature, then rinsed and plated.
5. As formed part cleaned and then electropickled in warm 10 per cent by volume sulfuric acid, rinsed and plated.
6. Same as No. 2 plus 180 grit belt polish before electropolish.
7. Same as No. 3 plus 180 grit belt polish before electropolish.

All electropolished parts performed better on salt spray and roof exposure tests. With the grade of steel being used, it was necessary to use a 180 grit polish to remove "orange peel" noticed when only electropolish was tested. A 10 minute electropolish was required to produce the luster required for the part after nickel plating.

Other observation of the process indicates that copper impurities do not plate out as an immersion deposit up to 200 ppm; that the solution will operate to etch nickel parts being replated and that the solution will operate with 1 per cent nickel and 3.5 per cent iron accumulations. It has the advantage of operating well at low current densities in the range of 25 to 50 amp/sq ft. Also, water absorption from the air is not a problem as occurs with concentrated sulfuric acid etches. With a given solution, it has been noted that less etching occurs at lower temperatures and/or at higher current densities.

OBSERVATIONS

Continued operation of the bath on steel and nickel replated parts results in a build-up of iron and nickel metal in the solution. As the build-up in these metals increases, the amount of magnesium in the bath decreases.

An advantage of the epsom salt–sulfuric acid anodic etch is that 25 asf will produce results similar to 200 asf in a 25 per cent by weight sulfuric acid solution.[4] This is a considerable reduction in the current and cooling capacity requirements and hence a saving in equipment cost and operating expense. Another cost factor is the high voltage requirement in the sulfuric acid type etch to maintain high current densities, which can require from 12–18 volts at the start of the etch to 30–35 volts when the work becomes "passive" and oxygen evolution occurs.[4] These voltages are extremes since they are also dependent upon such items as spacing, temperature and concentration of solution as well as current density. (Our particular operation would have required a 35 volt d-c power source at 20,000 amperes to etch one part at a time in a sulfuric acid type solution.)

There is no smut formation at the start of the cycle with

the anodic epsom salt–sulfuric acid etch such as occurs with a 25 per cent by weight sulfuric acid solution. As long as the solution is saturated with epsom salts and a minimum current density is maintained, no smut occurs. The possibility of smut forming is similar to the operating conditions for a 55° Bé sulfuric acid etch as listed by Pinner[11] and can be compared as follows:

55° Bé $H_2(SO_4)$	*Epsom salt—Sulfuric Acid*
Bath composition too dilute	Unsaturated with epsom salt
Temperature too high	Temperature too high
Current Density too low (150 asf normal)	Current Density too low (30 asf normal)

Pinner mentions that maintaining a minimum current density may be troublesome in recessed areas. This points out the advantage of maintaining a 30 asf current density rather than 150 asf. Pinner further suggested a cycle of an anodic electroclean and mild acid dip to remove smut from a surface and still retain the desirable characteristics of the anodic etch. In the process discussed in this paper, an anodic clean and acid dip after the epsom salt-sulfuric acid anodic etch, reduced the adherence, as measured by the bend test to less than 100 per cent good.

The length of time for anodic etching seems to vary with the type bath and application. Pinner[11] states that a 30 second anodic etch in the 55° Bé at 150 asf was sufficient to improve parts as measured by salt spray test. In the anodic epsom salt–sulfuric acid etch a 5 minute etch at 30–40 asf was required to assure passage of our bend test. Several times it was necessary to process parts that had become rusted. The rust was removed by soaking in the 10 per cent by volume muriatic acid dip. It was found that for each 5 minutes extra in the muriatic pickle, an extra minute in the anodic etch solution was desirable.

Some consideration has been given to the reason that the epsom salt addition provides the advantages cited so that the process can be used at its optimum condition or improved. For convenience, the solubility data on epsom salt (magnesium sulfate)–sulfuric acid from Seidell[12] is listed in Table II. This data was used to plot Fig. 3. By inspection of the data, it can be noted that as the concentration of sulfuric acid is increased, the solubility of the magnesium sulfate (epsom salt) decreases to a minimum and then increases. Table 3 lists data in which the solubility in a constant volume of solution has been calculated. The solubility of magnesium sulfate was calculated on the basis of the common sulfate ion; i.e., that the decrease in magnesium sulfate would be such as to maintain a constant solubility product. The calculated and actual solubilities of magnesium sulfate are in close agreement until the percentage by weight of sulfuric acid exceeds the percentage by weight solubility of magnesium sulfate in water. When the percentage by weight of sulfuric acid is greater than the percentage by weight of a saturated solution of magnesium sulfate in water, the solubility of the magnesium sulfate increases.

The data in Table II and Fig. 3 indicates that a correlation exists between the solubility of the magnesium sulfate and the solid phase in contact with the saturated solution. When the solid phase is $Mg(SO_4)\cdot 7H_2O$, the anhydrous magnesium sulfate in solution decreases until a minimum is reached where the solid phase is $Mg(SO_4)\cdot H_2O$. When the solid phase $Mg(SO_4)\cdot H_2(SO_4)\cdot 3H_2O$ appears the amount of $Mg(SO_4)$ increases to a maximum until the solid phase $Mg(SO_4)\cdot 3H_2(SO_4)$ occurs. Since it is quite normal for ions in a solution to be hydrated[13] (combined with one or more molecules of water) the correlation of solubility and solid phase may be an indication of the association of ions present in the solution. The more concentrated the solution the greater the interionic attractive forces, so that it may be possible to form a complex molecule in solution of the same composition of the solid phase plus the strong polar molecules of water. This would account for a number of observations made in the operation of the solution: (1) That the

Table II
Solubility of magnesium sulfate in aqueous solutions of sulfuric acid at 12.6° C from Seidell[12]

D of Sat Sol	Grams/100 gms sat sol		Solid Phase
	$H_2(SO_4)$	$Mg(SO_4)$	
1.2666	0.0	24.33	$Mg(SO_4)\cdot 7H_2O$
1.2729	8.64	19.25	$Mg(SO_4)\cdot 7H_2O$
1.2861	15.78	16.05	$Mg(SO_4)\cdot 7H_2O$
1.3267	24.28	12.23	$Mg(SO_4)\cdot 7H_2O$ $Mg(SO_4)\cdot H_2O$
1.3440	27.20	8.68	$Mg(SO_4)\cdot H_2O$
1.3592	28.95	11.92	$Mg(SO_4)\cdot H_2O$ 1:1:3*
1.3641	29.81	12.37	1:1:3
1.4390	33.74	15.16	1:1:3
1.4431	40.94	11.12	1:1:3 + 1:3*
1.4906	53.01	4.25	1:3
1.5688	59.10	1.50	1:3 + 1:1:3 (T)
1.6553	66.49	0.38	1:3
1.7780	82.31	0.21	1:3
1.8455	98.56	0.14	1:3

*1:1:3 = $Mg(SO_4)\cdot H_2(SO_4)\cdot 3H_2O$ and 1:3 = $Mg(SO_4)\cdot 3H_2(SO_4)$
(T)Temporary

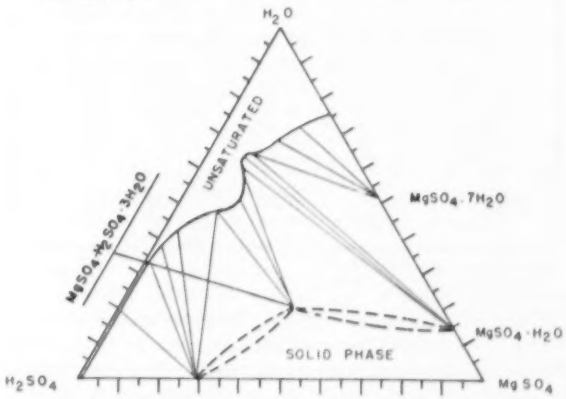


Fig. 3. Phase diagram for sulfuric acid, water and magnesium sulfate at 12.6° C (54.7° F). Data plotted as per cent by weight

Table III
From Table II calculate the decrease in solubility of saturated magnesium sulfate due to additions of sulfuric acid for a constant volume on solution. Calculations based on the solubility product being a constant. Solution density is listed for correlation with Table II

Solution Density	Actual gms $Mg(SO_4)$	Calculated gms $Mg(SO_4)$
1.2729	24.50	24.80
1.2861	20.64	20.71
1.3267	16.23	16.49
1.3440	11.67	15.65
1.3592	16.20	14.47

etching and smut formation normal with a 25 per cent by weight sulfuric acid bath does not occur in the epsom salt-sulfuric acid etch. Association of the sulfuric acid in solution changes the polarization conditions at the anode so that oxygen is evolved easier and the rate of dissolving iron decreases. (2) That the process operates best with a maximum of both sulfuric acid and magnesium sulfate. To accomplish this in the production unit a solid phase is maintained in the bottom of the tank and the concentration of the sulfuric acid is maintained to have a maximum of magnesium sulfate in solution. For control purposes a range of 25 to 26 per cent by volume sulfuric acid is satisfactory. Above 26½ per cent by volume the sulfuric acid forms $Mg(SO_4)\cdot 3H_2(SO_4)$ and the solubility of the magnesium sulfate decreases. (3) The lower the temperature the better the operation of the process. Association of the ions will occur easier at lower temperatures since the degree of thermal vibration is lower. (4) Buildup in the solution of iron and nickel contents decreases the effectiveness of the process. Although the common sulfate ion is still present, higher currents must be used to prevent the formation of a black smut on the work. This could be explained by the fact that the decrease in magnesium ion frees some sulfuric acid from the $Mg(SO_4)\cdot H_2(SO_4)\cdot 3H_2O$ complex. This freed sulfuric acid plus metallic ions and water tend to alter the anode polarization conditions and aid in dissolving iron. Hence, the higher current required under such condition to prevent smut formation.

Table IV
Solubility of sodium sulfate in aqueous solutions of sulfuric acid at 12.5° C from Seidell

Density	Grams/100 gms Sat Sol		Solid Phase
	$H_2(SO_4)$	$Na_2(SO_4)$	
1.0865	0.0	9.46	$Na_2(SO_4)\cdot 10H_2O$
1.2746	11.86	19.26	$Na_2(SO_4)\cdot 10H_2O$ + $NaH(SO_4)\cdot 5H_2O$
1.2608	18.73	30.40	$Na_2(SO_4)$ + $NaH(SO_4)\cdot 5H_2O$
1.4801	20.58	31.56	$Na_2(SO_4)$ + $NaH(SO_4)\cdot 5H_2O$
1.4868	22.06	30.15	$Na_2(SO_4)$ + $NaH(SO_4)\cdot 5H_2O$
1.4876	27.96	25.06	$Na_2(SO_4)$ + NaH $(SO_4)\cdot 1H_2O$NaH·5*
1.4080	36.91	10.86	$NaH(SO_4)\cdot 1H_2O$
1.4752	51.62	3.66	$NaH(SO_4)\cdot 1H_2O$
1.5720	59.42	3.71	$NaH(SO_4)\cdot 1H_2O$
1.6562	70.62	4.75	$NaH(SO_4)\cdot 1H_2O$ + NaH·H†
1.7780	81.74	5.65	NaH·H
1.9254	89.06	9.98	NaH·H

*NaH·5 = $NaH(SO_4)\cdot 5H_2O$
†NaH·H = $NaH(SO_4)\cdot H_2(SO_4)$

Although the writers have not to their knowledge encountered trouble due to halogen ions, it is possible that the increased current required when the ion and nickel content increase could be due to drag-in of chloride from the muriatic acid solution. Since the halogen ions generally reduce anode passivity, this possibility must always be considered.

AQUEOUS FILM CONCEPT

As the data on this process was studied, the opinion was reached that our classical concepts of "cleanliness" "active" and "passive" as used in discussing the preparation for plating was out of date. The hypothesis is that either one or a combination of the following occur in an anodic etch: (a) Oxygen gas is adsorbed on the anode surface; (b) OH ions are adsorbed on the anode surface; (c) HOH molecules are adsorbed on the anode surface.

That probably all of the above occur to some extent and are held by the available valence forces present on a "clean" metal surface. With a perfectly "clean" surface, forces are uniformly available over the entire surface, hence, the term "free from waterbreak" and its usefulness in plating. This adsorbed aqueous film on the anode surface protects the work during transfer and rinsing operations until the part becomes the cathode in an acid plating solution where it quickly reacts leaving the metal surface in ideal condition for plating.

By analogy it is possible that in an acid solution, the reaction of the metal and acid produce the necessary hydrogen and "clean" surface so that the following can occur: (a) Hydrogen gas is absorbed on the metal surface; (b) Oxonium ions (H_3O) are adsorbed on the metal surface; (c) HOH molecules are adsorbed on the metal surface.

The above concept is at least useful and seems to satisfy a number of practical requirements in the preparation of metal surfaces for plating. For example: a "chemically clean and active surface" is generally accepted as a necessary requirement for plating. In the ASTM methods of preparation for electroplating, the terms "reactivation" and "final activation" are used. However, no explanation is offered as to how such a clean and active surface could be transferred and rinsed without surface reactions taking place.

The above aqueous film concept explains how, after the surface is cleaned by reaction with the acid or anodic electrolysis, the surface is protected during transfer and rinsing until the electroplate is applied.

Such an aqueous film would have properties: (1) that would vary dependent upon concentration, temperature, current density, anode reactions, etc.; (2) that such a film would be a conductor; (3) could have a measureable potential; (4) that anodic solution of the metal can continue as a process but is not the rate controlling process, and (5) that the film would have a short life since the surface water would be the only visible evidence of the film (also the reason it was not recognized before).

ASTM has noted the application of an anodic etch[7] in securing adhesion for plating of high-carbon steel, also noted is the improvement of the uniformity of the plate distribution and reduction of hydrogen embrittlement. ASTM also suggests the addition of sodium sulfate as being beneficial. While the writers have not used this solution, solubility data (Table IV) and a phase diagram (Fig. 4) are shown, for use in comparing with the epsom salt–sulfuric acid solution (Fig. 6).

ASTM suggests a sulfuric acid solution containing from 250 to 1000 g/l at a temperature maximum of 86° F (30°C) and preferably below 77° F (25° C) with 125 g/l anhydrous sodium sulfate. In the writers' opinion, a narrower range of acid concentration and saturation with sodium sulfate would probably produce better results. It would be of interest to determine if a difference in the etching action between the bath with a double salt $Mg(SO_4)\cdot H_2(SO_4)\cdot 3H_2O$ and an acid salt ($Na\cdot H\cdot SO_4\cdot 1H_2O$) is appreciable. The relative solubility of iron and nickel in the two process solutions may also play an important role in future usage.

More information is needed on the anodic process to be able to generalize:

1. Is the adhesion obtained dependent upon the production of pores for a mechanical bonding or is a better metallic bond obtained?

2. Does the process produce some type of anodic polarization that has a short life period lasting until metal is applied to the surface cathodically? Or is an actual porous film produced that improves adhesion in a manner similar to the oxide film used to plate aluminum?

3. What is the role of the epsom salts and the effect of other metal ions in operation of a bath of this type?

4. What is the importance of different application of current?

(a) Does the number of ampere minutes play an important role?

(b) Is current density asf the most important factor or does the ratio of the current strength to the volume of the anode film of electrolyte have some meaning?

(c) In the strong electrolyte does the apg (amp/gal) have a special meaning and importance.

CONCLUSIONS

The use of an anodic etch in a epsom salt–sulfuric acid solution is described which has been used to obtain good adhesion of nickel plate upon low carbon steel parts.

An "aqueous film" concept has been offered to serve as an explanation to the practical plater of the surface conditions that occur in the preparation of metals for plating.

It is the writers' opinion that the study of the anodic processes will provide needed information on the preparation of metals for plating.

APPENDIX

The selection and use of the epsom salt–sulfuric acid anodic etch was to solve a production problem involving good adhesion of a nickel coating to steel at a minimum cost. A review of the operating data for the plant historical record suggested the writing of this paper. The necessary literature search on anodic etching clearly revealed our lack of knowledge on this and other factors in the preparation of metals for plating. The AES Research Report[14] emphasized many important points but in the writers' opinion the following statements listed by E. H. Lyons[15] seem to summarize our need for information:

(a) ". . . rarely, if ever, does a metal article to be plated enter the electroplating bath with a truly clean surface. Various types of films are present on the surface."

(b) ". . . an acceptable surface is one on which objectionable surface films have been replaced by films more suitable and acceptable for electroplating."

(c) ". . . oxide films can be, and are, removed by an acid dip, but even if the wet surface is kept acidic, oxide films are usually found again on the surface by the time plating begins."

The "aqueous film" concept was then postulated as a practical explanation of how both anodic acid etch and acid dips are successfully used in commercial plating. It also suggests that the cleanliness of the surface is secondary to how the surface is "protected" from the time it becomes clean until the electrodeposition process begins. In line with this trend, it follows that different types of metals will require different types of films. That the action of the plating bath on these films will be different particularly for alkaline and acid baths. In short, then, the most important factor in the cleaning and preparation of metals for plating is the "film" to protect a clean surface until plated.

A number of recent publications will be helpful in future studies on this matter. Bartlett and Stephenson[16] have published an interesting paper on "Anodic Behavior of Iron in H_2SO_4" that describes three distinct stages of Active, Transition and Passive dependent upon the applied voltage. In the transition zone, a periodic phenomena is noted where current bursts occur. These bursts could be due to release of adsorbed hydrogen from the anode surface. Also, a paper on the "Anode Polarization Effects of Nickel in Sulfuric Acid" by Turner[17] and comments by Hoar[18] should be noted.

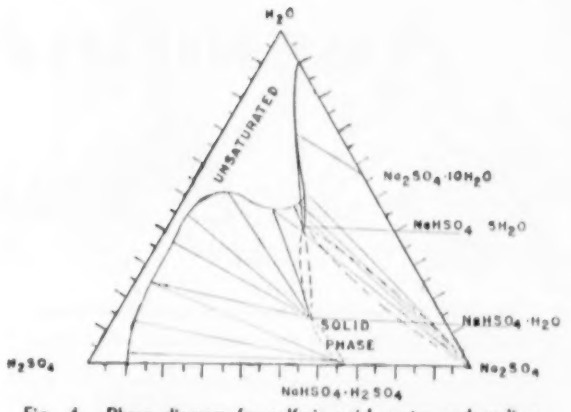


Fig. 4. Phase diagram for sulfuric acid, water and sodium sulfate at 12.5° C (54.5° F). Data plotted as per cent by weight

Elze and Fischer[19] state: "From the electrochemical point of view, iron in an acid is a multiple electrode upon which a number of potential determining processes act simultaneously." Thus the rate controlling process will vary in different solutions and with different conditions. Since electropolishing has proven so successful in the reproduction of a standard surface with a given material, it is reasonable to suppose that an anodic treatment can reproduce film conditions useful in the preparation of metals for plating.

Gatos and Uhlig[20] have established that preexposure of a clean iron surface to oxygen for 30 minutes decreases the rate of iron dissolved by one half. Since this condition can be removed by evacuation after oxygen exposure, it indicates an adsorption phenomena rather than an oxide formation. It is then possible that the evolution of oxygen during anodic etching can be adsorbed in the aqueous film concept in a hydrated form.

Other factors that may be involved with the role of oxygen in anodic processes, such as rate of anode dissolution and minimum current density for "passivation" could be developed from the article by Hoar and Evans.[21]

The complexity of the number of factors effective in the different reaction of metal surfaces with ions is listed by Simnad[22] and is abstracted as follows:

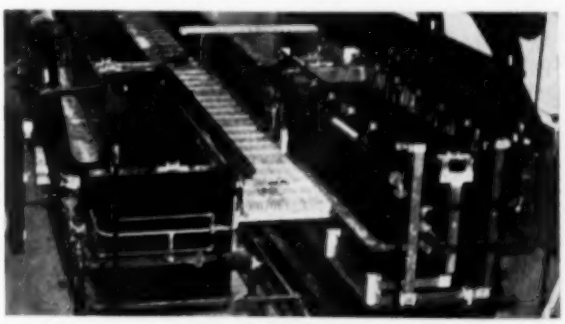
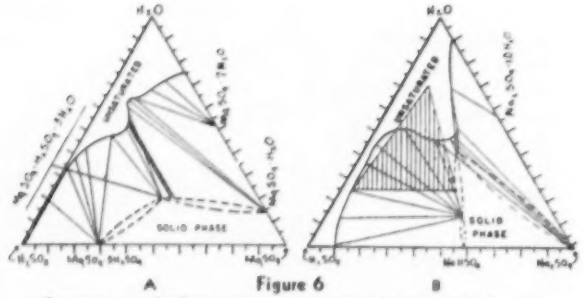


Figure 5
A general view of the plating equipment showing the 11 foot deep tanks



A Figure 6 B

Comparison of operating ranges as noted by the marked areas

A. Phase diagram for sulfuric acid, water and magnesium sulfate at 12.6° C (54.7° F). Data plotted as per cent by weight.

B. Phase diagram for sulfuric acid, water and sodium sulfate at 12.5° C (54.5° F). Data plotted as per cent by weight.

REACTION OF METAL SURFACES WITH IONS IN SOLUTION

(a) Continuous exchange between metal ions in solution and the atoms on the metal lattice.
(b) Adsorption of the metal ions.
(c) Electrolytic action on the metal surface.

Factors that affect the above reactions are:

(1) The distribution of local anodes and cathodes on the metal surface.
(2) The influence of oxygen in solution.
(3) The orientation of the metal grains.
(4) Stresses.
(5) The position of the metal surface in the emf series with respect to the ions in solution.
(6) The platability of the ion on the cathodic parts of the metal surface.
(7) The conductivity of any film formed on the surface.
(8) Temperature.
(9) Diffusion coefficient.
(10) Inter-relation of above such as temperature effect on the diffusion coefficient.

Since a new metal surface is so active and the possible reactions so numerous, it follows that an operation which can produce a new metal surface and film it with a known reproducible and controllable coating until plating occurs is the most important single factor in the electroplating field. The evidence indicates that anodic etching of metals may be the long needed procedure.

The fact that freshly disturbed metal surfaces emit negatively charged particles which can actuate an open ended Geiger counter have been discussed and tested by Grunberg.[33] The active electrons at the surface of the metal may combine with the oxygen present in anodic etching to form a temporary passive coating similar to that formed in concentrated nitric acid.

A recent technique developed by Hoar[34] in studies of electropolishing for deciding whether an invisible, compact, nonmetallic solid film is present on the surface of a metal may be of use in studying anodic etching. Mercury is dropped on the surface; if it wets and spreads on the surface, there can be no solid film; if it does not wet the presence of such a solid film is indicated.

In his "Mathematical Theory of the Faradaic Admittance," Grahame[35] gives a nice presentation of the number of problems that exist in understanding the conditions of a metal surface in contact with an electrolyte.

Marshall[36] discusses the effect of the time between etching and start of deposition, the effect of smut upon adhesion and the effect of *p*H of the nickel solution upon adhesion for a chemical method of treating steel. Many of the observations are similar to the results obtained with an anodic etch.

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Lead-Tin-Antimony Plating*

By R. T. PUTNAM and E. J. ROSER†

ABSTRACT

This paper describes the plating and control procedures and the solution developed to plate a lead base alloy containing 11 per cent tin and 7 per cent antimony and discusses the effect of variations of plating conditions and solution composition.

INTRODUCTION

The addition of antimony to a lead, tin alloy hardens and strengthens the alloy. It is probable that a lead-tin-antimony plated overlay bearing surface has greater erosion and wear resistance than has a lead-indium or lead-tin overlay. Preliminary tests have indicated that a simultaneously plated alloy with nominal composition of 11 per cent tin, 7 per cent antimony, remainder lead shows promise of accomplishing this improvement without seriously impairing the other good bearing qualities inherent in the lead-indium or lead-tin overlay bearing.

PROCEDURE FOR PLATING PANELS

In order to determine the effects of varying solution compositions and plating conditions on the plated alloy composition, alloys were electrodeposited on panels for analysis. The test panels were 1 inch x 1 inch stainless steel and were polished to facilitate removal of the plated alloy prior to analysis. A 500 ml solution of lead-tin-antimony fluoborate solution and anodes with a composition of 12 per cent tin, remainder lead were used in these plating tests. Solution agitation was supplied by a rotating stirring rod.

The antimony content of the alloy plated on panels was found to be about 2 per cent to 3 per cent higher than the antimony content of the alloy plated on the ID of cylindrical bearings when using the same overall plating conditions. This difference in antimony content is the result of different current density distribution obtained on the two types of cathodes and the effect of variation in current density on the antimony content of the plated alloy.

EFFECTS OF VARIATIONS OF SOLUTION CONSTITUENTS

Organic addition agents are necessary to permit plating of smooth dense deposits with the desired analysis. Of the many materials tested, a combination of Lactalbumin Peptone‡ and hydroquinone was considered to give the best results. Varying the solution content of hydroquinone between 0.25 g/l and 3.0 g/l did not result in any change in the plated alloy composition. For the solution's hydroquinone content, 0.50 g/l was selected.

Increasing amounts of peptone in the solution caused the tin in the plated alloy to increase and the antimony to decrease. This is shown in Figure 1. A peptone content of 15.0 g/l was selected for the standard solution; at this concentration, the rate of change in the plated alloy composition was very small as the peptone content varied.

These addition agents apparently have a very long effective life. After plating more than 1000 bearings in a 90-gallon pilot solution, tests made on small quantities of the pilot solution showed no tendency for added peptone and hydroquinone to change the plated alloy composition.

Increasing the lead content of the solution within the range of 50 g/l to 200 g/l resulted in a rather sharp decrease in the tin content of the plated alloy and a slight decrease in the antimony content as shown in Figure 2. The nominal lead content of the solution was established at 100 g/l. Experience in plating bearings has shown that the lead content of the solution maintains itself with no appreciable change.

The effect on the plated alloy composition of varying the stannous tin content of the solution is shown in Figure 3. As the solution tin content increased, the tin content of the plated alloy increased and the antimony content of the alloy was unchanged. A solution tin content of 30 g/l was found to give the required tin content in the plated alloy. Plating experience has shown that, in use, this solution maintains the tin content with no appreciable change.

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*Presented at the 42nd Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

†Pratt and Whitney Aircraft Corporation.

‡Sheffield Chemical Co., Inc.

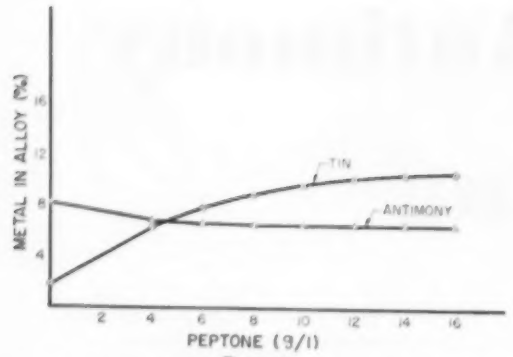

Figure 1
Effect of Solution Peptone Content on the Electroplated Alloy Composition

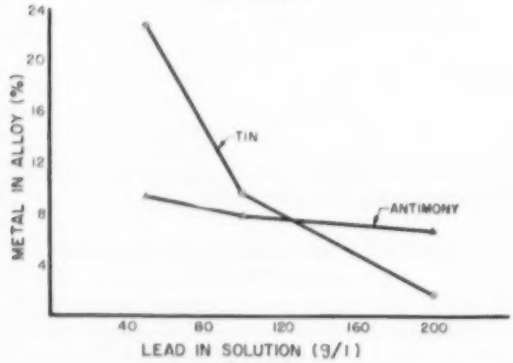

Figure 2
Effect of Solution Lead Content on the Electroplated Alloy Composition

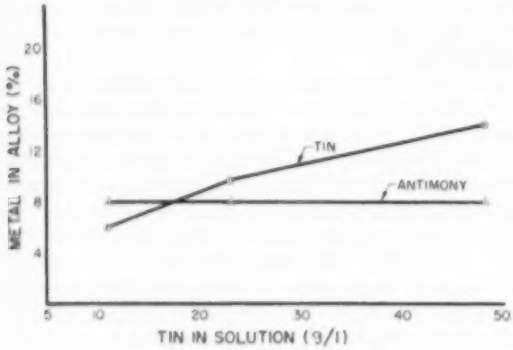

Figure 3
Effect of Solution Tin (Stannous) Content on the Electroplated Alloy Composition

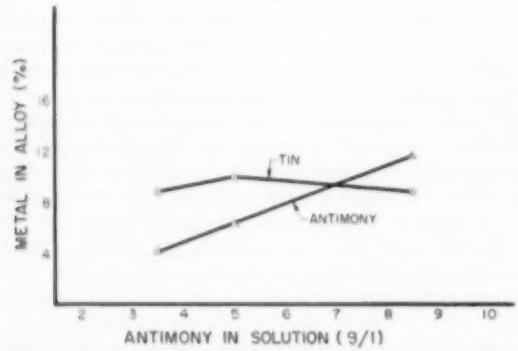

Figure 4
Effect of Solution Antimony Content on the Electroplated Alloy Composition

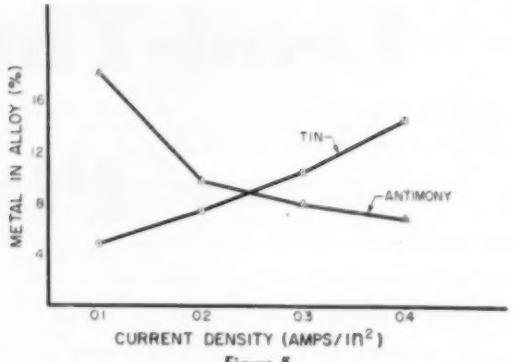

Figure 5
Effect of Current Density on the Electroplated Alloy Composition

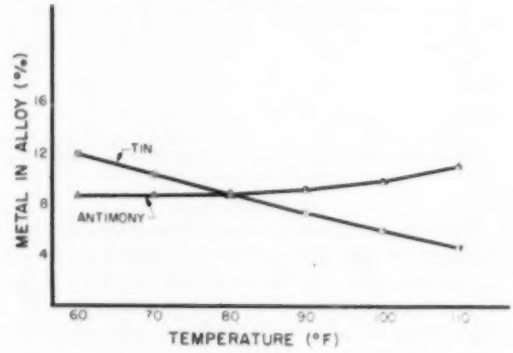

Figure 6
Effect of Solution Temperature on the Electroplated Alloy Composition

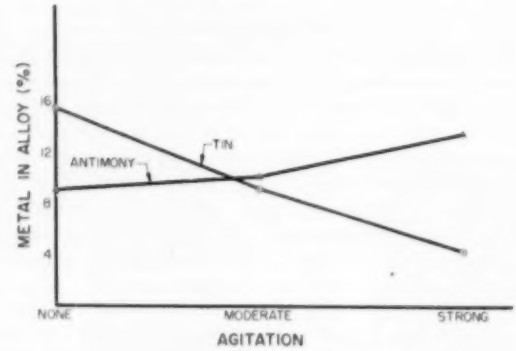

Figure 7
Effect of Solution Agitation on the Electroplated Alloy Composition

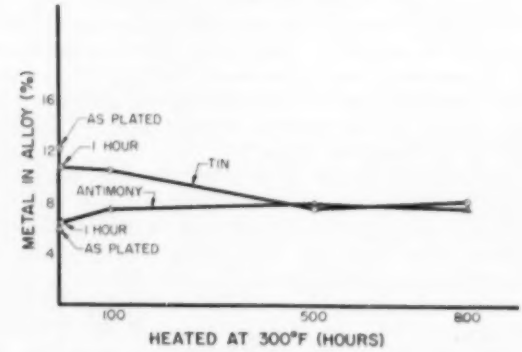

Figure 8
Effect of Heating the Electroplated Alloy on the Composition of the Alloy

LEAD-TIN-ANTIMONY

MATERIAL	ALLOY COMPOSITION
TIN	11.0%
ANTIMONY	7.0%
LEAD	REMAINDER
	SOLUTION COMPOSITION (NOMINAL)
LEAD FLUOBORATE (AS LEAD)	100 g/l
TIN FLUOBORATE (AS STANNOUS TIN)	30 g/l
ANTIMONY FLUOBORATE (AS ANTIMONY)	6 g/l
FREE FLUOBORIC ACID	80 g/l
BORIC ACID	25 g/l
HYDROQUINONE	0.5 g/l
PEPTONE (LACTALBUMIN PEPTONE)	15 g/l
TEMPERATURE	70° F
CURRENT DENSITY	0.25 A.S.I.
AGITATION	VERY MILD

Figure 9
Lead, Tin, Antimony Alloy Composition, Solution Nominal Composition and Plating Conditions

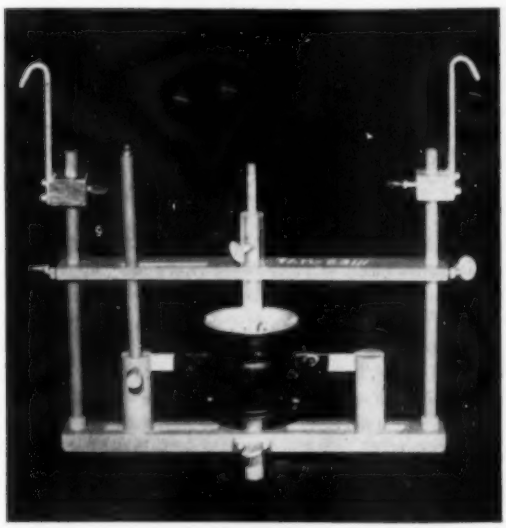

Figure 10
Fixture for Holding Bearing and Locating and Centralizing Anode

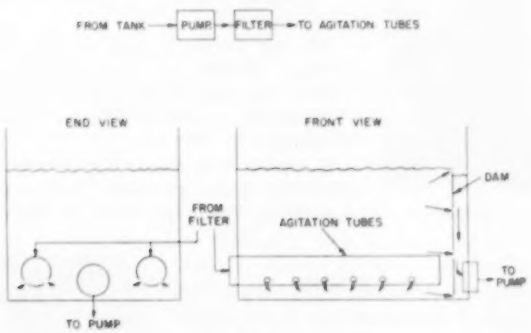

Figure 11
Solution Agitation System

As the antimony content of the solution increased, the antimony content of the plated alloy increased and the tin content was essentially unchanged. This is shown in Figure 4. It was found desirable to maintain the solution antimony content at 6 g/l. The solution antimony content must be maintained by adding concentrated antimony fluoborate solution since the anodes used contained no antimony.

Variations in the free fluoboric acid content of the solution in the range of 50 g/l to 110 g/l had no appreciable effect on the plated alloy composition. This establishes a wide tolerance from the nominal fluoboric acid content of 80 g/l.

Lead and tin fluoborate concentrates contained some free boric acid. Additional amounts of boric acid up to 25 g/l were found to have no appreciable effect on the plated alloy composition. Since boric acid would be removed by drag out, an addition of 25 g/l of boric acid was established as a requirement for making up the plating solution.

EFFECTS OF VARIATIONS OF PLATING CONDITIONS

The effect of variation in current density on the composition of the plated alloy is shown in Figure 5. The tin content of the plated alloy increased rapidly but at a nearly uniform rate as the current density was increased from 0.1 asi to 0.4 asi. The antimony decreased rapidly but at a decreasing rate as the current density was varied from 0.1 asi to the nominal of 0.28 asi. Above the nominal current density, the antimony content of the plated alloy decreased at a lower and more uniform rate.

The effect of variation in solution agitation on the plated alloy composition is shown in Figure 7. Increased agitation decidedly decreased the tin content of the plated alloy and increased the antimony to a lesser degree. Agitation of a plating solution is difficult to define. The degree of agitation expressed here as strong might be considered very mild by comparison with agitation normally used by platers. Experience in lead, tin, antimony plating of bearings has indicated low velocity, high volume pump agitation, uniform throughout the solution, to be most desirable. Impingement of localized high velocity agitation on an area of the cathode resulted in shiny, brittle low tin, high antimony content deposit in that area.

Increasing the solution temperature decreased the tin content of the plated alloy as shown in Figure 6. Below 90° F, temperature had very little effect on the antimony content; above 90° F, the antimony content increased. A temperature of 70° F was standardized for bearing plating; this temperature could be easily maintained the year round with a low output cooling system.

ALLOY AND SOLUTION COMPOSITIONS AND PLATING CONDITIONS

Figure 9 shows the nominal plated alloy composition, solution composition and plating conditions established for plating bearings. Acceptable variations for alloy composition were specified as ±2 per cent for both tin and antimony content. The lead, tin, antimony and free fluoboric acid content of the solution were maintained as close to nominal as practicable by additions when solution analysis indicated the necessity. The composition figures given for boric acid, hydroquinone and peptone were used for making up the solution. Solution temperature was controlled at 70° F ±2. Optimum current density was determined for each type of bearing plated and was found to vary only slightly from nominal.

EFFECT OF HEATING PLATED BEARINGS

Deposits of lead-tin-antimony plated on silver in accordance with the procedure established for plating bearings were subjected to heating at 300° F for up to 800 hours. After heating there was no evidence of blistering indicating that the plated alloy was well bonded to the silver. Figure 8 shows the

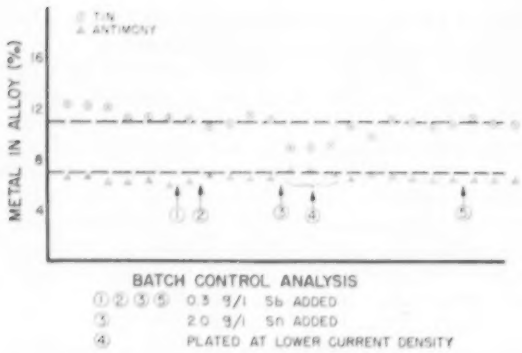

Figure 12
Analysis of Control Bearings Plated Before and After Each Batch of Bearings Processed

analysis of the lead-tin-antimony plated alloy at various points during the heating cycles. Loss of tin in the alloy due to diffusion into the silver was considered low and there was no apparent loss of antimony.

PROCEDURE FOR PLATING BEARINGS

Bearings for rig, experimental engine and service tests were two-piece steel backed, silver lined bearings. Figure 10 shows a bearing with the back stopped off with wax, and the fixture for clamping the two piece bearing and holding and centralizing the anode. The procedure for processing the lead-tin-antimony overlay was essentially the same as is used for lead-indium overlay plating.

1. Dimensionally inspect and code wall thickness.
2. Degrease.
3. Assemble clamping fixture to hold two bearing halves together.
4. Wax areas not to be plated.
5. Scour area to be plated with pumice and alkali cleaner.
6. Rinse in cold water.
7. Affix part in anode holding fixture, and assemble anode.
8. Rinse and plate in lead-tin-antimony plating solution at the prescribed current density and for the time necessary to obtain 0.00125 inch plate thickness.
9. Rinse in cold water and neutralize in alkali.
10. Rinse in cold water and remove anode and anode holding fixture.
11. Immerse in water-displacing oil.
12. Degrease to remove wax.
13. Disassemble clamping fixture.
14. Mark with batch number.
15. Heat-test in oil at 340° F for 2 hours.
16. Clean in a light oil.
17. Inspect visually for blisters, roughness, bare spots, etc. Inspect dimensionally for lead-tin-antimony overlay thickness and for retention of required tapers and reliefs.

PLATING EQUIPMENT

The equipment used in lead-tin-antimony plating of bearings for engine testing consisted of a 90-gallon plastic-lined tank, with a rectifier and ammeter available for each bearing being plated. Agitation was supplied by a small rubber-lined pump with the outlet being holes in plastic pipe located near the bottom of the tank. Agitation was controlled by a bypass to a point where solution motion was just visible at the solution surface. Temperature was maintained at 70° F with an automatic temperature controller and plastic tubing heat exchanger. The solution was continuously filtered through rubber-lined Fulflo type filter using cotton filter tubes. Figure 11 shows the agitation system used.

PLATING CONTROL

Bearings were lead-tin-antimony plated in this semi-production setup by production personnel. Control was maintained by inspection and laboratory personnel following general procedures used for controlling production plating. Test bearings were plated for analysis of the plated alloy before and after each batch, a batch being the bearings plated by one shift in one day. The solution was analyzed periodically, and additions were made as required. Figure 12 shows the control results for the plating of 1,270 bearings over a period of 3 months for experimental and service engine testing. During this period only four small additions of antimony fluoborate concentrate were made, at points indicated. One addition of tin fluoborate was made during this period, as indicated, when analysis of test bearing showed low tin content. Three batches of bearings were plated with tin content of about 9 per cent, on the low side of the tin requirement, but it was subsequently found that these three batches were plated at lower current density than had been established for this particular bearing. Figure 12 shows the excellent uniformity of analysis of lead-tin-antimony alloy that can be attained under production conditions when the prescribed plating conditions are rigidly adhered to and controlled.

CONCLUSION

A solution has been developed from which an alloy with a nominal composition of 11 per cent tin, 7 per cent antimony, and remainder lead can be simultaneously electrodeposited. The effects of variation of individual constituents of the solution on the plated alloy composition have been investigated and determined. The effects of variations of current density, temperature and agitation have also been investigated and determined. Equipment and a procedure have been developed for plating bearings and have been shown adaptable for production use with excellent control of the plated alloy.

R. T. PUTNAM

Putnam

Reginald T. Putnam was born in Windsor, Conn., in 1903. He received a B.S. degree in Chemistry from the University of Connecticut in 1926.

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Roser

Elijah J. Roser was born in Port Richmond, Staten Island, N. Y. in 1919. He spent eight years in the U. S. Navy and was discharged with the rank of Chief Machinist Mate. He attended Kent State University and the University of Connecticut before joining Pratt & Whitney Aircraft in 1949. At present he is a chemist in the Electrochemical Division of the Materials Development Laboratory.

Metal Cleaning Studies Using Radioactive Tagged Soils*

BY J. W. Hensley and R. D. Ring†

ABSTRACT

Quantitative studies of metal cleaning processes have been limited in the past by lack of adequate methods for evaluation of soil removal. The use of radioactive isotopes in tagged soils makes it possible now to carry out studies on the variables involved in metal cleaning processes that should permit better evaluation of mechanisms of importance in soil removal. Better understanding of the processes should result in more efficient cleaning operations. Data are presented from electrocleaning tests showing the effect of such cleaning variables as alkali concentration, cleaning time, current density, and current direction on the removal of tagged stearic acid soil from steel test pieces. It is shown that high alkali concentration may be detrimental in removal of stearic acid soil, but that surfactants tend to counteract the adverse concentration effect. Variation in current density of itself appears to have a small effect on removal of stearic acid soil, but the effect of current density and concentration are interrelated, and in some cases change in current density has a large effect. The effect of initial soil level was investigated, and it was found, in the case of stearic acid, that the initial soil level used affects the relative evaluation of the electrocleaning efficiency of alkalies. It is pointed out that some effects of electrocleaning variables are peculiar to a fatty acid soil, and data are presented showing that the effect of concentration and current density variations are distinctly different with a tagged mineral oil soil.

INTRODUCTION

Although the published literature on metal cleaning processes is fairly voluminous, there is a notable scarcity of quantitative studies of the actual cleaning processes and mechanisms involved. Quantitative investigations most commonly have been directed toward individual phenomena known to be related to the cleaning process in some degree, such as emulsification, saponification, peptization, surface tension, interfacial tension, and others. Of necessity such studies generally are made in such a way as to separate the phenomenon involved from any actual cleaning process. Such fundamental studies are of unquestioned value in furthering our knowledge of metal cleaning and detergency processes in general. Systems involved in actual cleaning processes are, however, relatively complex compared with those used in the study of isolated phenomenon, and a cleaning process may be difficult to interpret in terms of fundamental concepts. Further quantitative cleaning studies with some investigation of the effect of variables involved should be of aid in understanding and improving the various metal cleaning processes.

The scarcity of quantitative metal cleaning studies has been due in large part to the lack of adequate methods for measuring soil removal. A variety of tests have been devised for estimating the cleanliness of metal surfaces. Some are quite useful as preliminary or screening type laboratory tests for metal cleaner performance. Review of these test methods has been presented by Linford and Saubestre,[1] and they will not be discussed further here. All of the previous test methods for evaluating soil removal have had inherent limitations in terms of sensitivity, accuracy, types of soils, or types of surfaces that could be employed that have discouraged their use in any comprehensive studies of metal cleaning processes.

Of recent years, however, radioactive tracer techniques have provided a method for measurement of soil removal that, in contrast to the other more conventional tests, has no fundamental limitations in terms of sensitivity, accuracy, types of metal surfaces and cleaning procedures that may be used. There are some practical limitations on the types of soils that may be employed at present in radioactive tracer tests, and on methods of soil application. These limitations will be minimized in time, but meanwhile the currently feasible tracer tests are adequate to provide a great deal of new information on metal cleaning processes.

When a variety of radioactive isotopes became available to industrial users, we undertook to develop some test procedures for evaluation of metal cleaning using radioactive tagged soils. Our initial approach was to investigate the removal of the individual soil components believed to be of the most practical importance. Such soils include mineral oils, saponifiable oils, fatty acids, insoluble soaps, and particulate or smut-type soils such as finely-divided carbon, metal, and oxide particles. So far, we have employed as metal soils tagged stearic acid, mineral oils, calcium stearate, and carbon smut, and suitable test procedures have been worked out for each. Preliminary trials have been made with tagged clay and tagged calcium carbonate particles as smut-type soils. The radioactive tracer cleaning evaluations have been used primarily as laboratory methods for investigations of cleaning processes. They have proven useful also, in conjunction with other tests, for screening evaluations in formulation work and for preliminary comparisons of cleaners prior to plant-scale trials.

The greatest part of this work has been done with radioactive stearic acid as the soil. This was not because we considered fatty acid soils as the most important type to study,

*Presented at the 42nd Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

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but it was considered a suitable starting point. Stearic acid was the first tagged material obtained that was suitable for metal cleaning test soil, and test procedures were worked out first for it. Some initial metal cleaning studies using the tagged stearic acid soil, primarily involving soak cleaning tests with limited data on electrocleaning, have been presented previously.[2,3] This paper covers additional electrocleaning studies with the stearic acid soil, along with some test results using a tagged mineral oil soil. Data on the latter soil were included primarily to illustrate the difference in behavior of the different types of soil with variation in cleaning conditions. It is expected that additional test data for the tagged mineral oil as well as for other types of soil and with base metals other than steel will be presented in subsequent papers.

EXPERIMENTAL

MATERIALS

The stearic acid-1-C_{14} used as soil in this work was synthesized* and was specified to contain 1 millicurie of carbon-14 activity in 1.41 grams of the acid. Chemical purity was specified to be 99 per cent or better. The stearic acid was used at full specific activity—i.e., it was not diluted further with inactive stearic acid.

The radioactive mineral-oil soil consisted of heneicosane-1-C_{14} dissolved in a paraffin-base lubricating oil. The radioactive heneicosane (21-carbon, straight chain, saturated hydrocarbon) was synthesized by Isotopes Specialties, Glendale, California. Specific activity was approximately 1 millicurie in 0.28 gram of hydrocarbon. Lubricating oil used in combination with the tagged heneicosane was "Metrobase," SAE 30, a paraffinic base stock, free from additives. The tagged oil used for soiling consisted of 10 per cent radioheneicosane and 90 per cent "Metrobase" oil.

The stearic acid-1-C_{14} and the heneicosane-1-C^{14} were purchased under allocation by the U. S. Atomic Energy Commission.

The alkalies used in cleaning tests were of commercial grade, from stocks checked and set aside specifically for cleaning test work. The sodium metasilicate was 5-hydrate, the trisodium phosphate, 12-hydrate, and the others anhydrous. Cleaner solutions were prepared with distilled water. Concentrations of alkaline solutions are stated as per cent Na_2O in solutions. These values are based on total alkalinities of the alkalies, as determined to the methyl orange endpoint.

The Kreelon-4D* used in some tests is a commercial surfactant of the sodium alkylarylsulfonate type, containing 40 per cent active agent, with the balance sodium sulfate.

PREPARATION OF STEEL COUPONS

The test coupons were in the form of 1.5 inch discs, punched from 0.012 inch cold-rolled steel, SAE 1020. The discs were given a preliminary cleaning with chlorinated solvent and wiped with filter paper. They were then given a standard polished surface with the machine shown in Fig. 1. This machine is a modification of one described in detail in a previous paper[2] and the operating principle is the same. The test disc is held in the small turntable, which, in operation, is pressed upward against an abrasive disc by means of a weight and lever arrangement. Effective pressure is about nine pounds. The abrasive is "Wetordry" paper (silicon carbide) which is fastened to a felt-covered aluminum disc. Turntable and abrasive disc are rotated in the same direction at 96 and 100 rpm respectively. The two are off-center sufficiently so that the edge of the test disc being polished does not overlap the center of the abrasive disc.

In these tests, polishing was done with No. 220 Wetordry, used with water applied to the abrasive surface with an atomizer. A test disc first was given a preliminary polish for 50 revolutions using a previously used abrasive disc. That abrasive disc was then exchanged for a new one, which was run for 15 revolutions to produce the final finish. This procedure of finishing with a fresh abrasive surface was adapted when it was found that after 15 to 20 revolutions the abrasive began to break down fairly rapidly, producing a more variable finish. After polishing, the discs were brushed under running water, rinsed with distilled water, and dried immediately by blotting with filter paper. This polishing procedure produced a surface with a uniform, matte appearance, with a roughness of about 13 microinches as measured with a Profilometer. A photomicrograph of the surface produced has been presented previously.[2] Soil was applied to each test disc immediately after surface preparation.

SOIL APPLICATION

The tagged soils were applied to the polished steel coupons with the machine shown in Fig. 2. This applicator has been described in detail in a previous paper.[2] The metal disc to be soiled is held by a turntable, and a known volume of a solution of the soil material is applied from a self-filling micropipette, the tip of which rests lightly on the metal disc. As the turntable rotates, the micropipette traverses slowly from the center of the disc toward the edge. By proper adjustment of the pipette bore, the volume of solution, the rate of traverse, and the speed of rotation, the solution can be made to flow onto the metal in a continuous and essentially uniform film. All of the solution is drawn out of the pipette, and a fixed area is covered.

The tagged stearic acid soil was applied in a kerosine solution, and after application, the kerosine was evaporated under a heat lamp to leave a thin film of solid stearic acid. The kerosine used was a specially purified, narrow-cut material, which evaporated cleanly. The standard, light soil was applied as 5 microliters of solution containing 34 micrograms of stearic acid. Much heavier soils were applied by increasing the concentration of the soiling solution and by employing multiple applications, with evaporation of the solvent after each application.

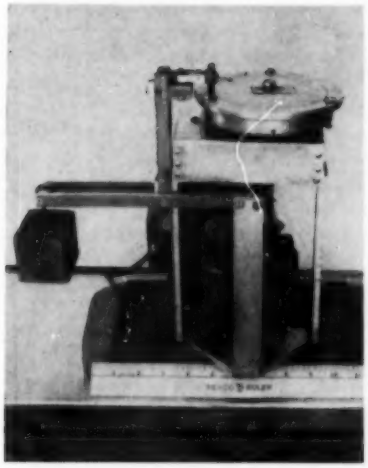
The tagged oil was applied to the steel discs in the same general way, except that benzene was used as the solvent, and a more concentrated solution was used to give a higher initial soil level of 300 micrograms per disc. The solvent was allowed to evaporate from the oil film without heating. As the oil continued to spread slowly on the disc after application, it was found desirable to standardize on a short time interval between soil application and cleaning.

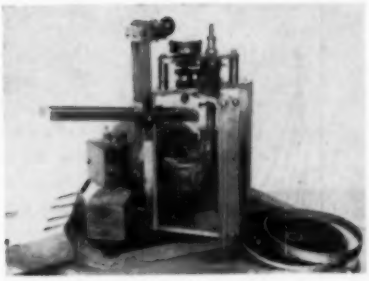
ELECTROCLEANING PROCEDURE

Electrocleaning tests were run in a 500 ml stainless steel beaker, with the assembly shown in Fig. 3. Two soiled discs were cleaned simultaneously between the two stainless steel electrodes. Unsoiled surfaces of the discs were pressed together, and as the discs were cupped somewhat as a result of the polishing process, with backs concave, the edges formed an effective seal. Current was provided by a plating-type rectifier, with variable transformer control.

All tests reported here were performed at 90° C (194° F), with the beaker immersed in a constant-temperature bath. Cleaner solution volume was 300 ml, and a fresh portion was

*Texas Research Foundation, Renner, Texas





B—Polishing machine disassembled

Fig. 1
A—Polishing machine for surface preparation of metal test discs

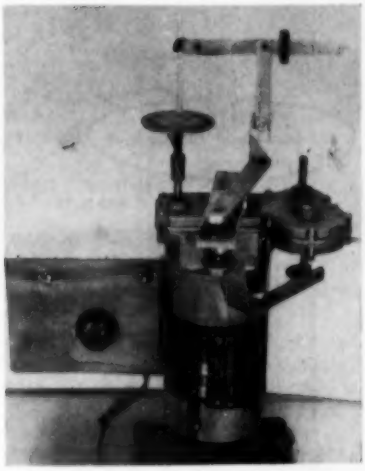


Fig. 2. Soil applicator, for applying radioactive soils in solution to metal discs

used for each pair of discs. After cleaning, the test discs were rinsed by dipping ten times in each of two portions of distilled water. Discs were then allowed to air-dry before counting.

MEASUREMENT OF RADIOACTIVITY

Initial and final soil levels were determined for each disc by taking counts before and after cleaning. Since initial soil level was constant with each type soil, initial counts on each disc would not be essential, except as a check on the soiling. Measurements were made with an end-window Geiger tube and scaler. The Geiger tube (TGC-2) had a window thickness of 1.9 mg/sq cm, and was mounted in a shielded sample changer providing a reproducible counting geometry. Sufficiently long counts were taken to give a statistical standard deviation of 2 per cent or less. It was necessary to correct the counts only for background. At counting levels involved, coincidence losses were negligible. Self absorption corrections also would be negligible with the very thin films of material involved. Since all samples were counted under identical conditions and related to counts per minute for known amounts of soil spread the same way on the same backing, no other corrections were required.

PRECISION AND CONTROL OF TESTS

Cleaning tests reported here were run with duplicate test coupons, and in most cases results have been verified with a second series of duplicate tests. Residual soil values for duplicate tests generally check within about 10 per cent. Average values for duplicates generally can be reproduced within about 5 per cent. It has been found, however, that over a period of time the removal characteristics of the soil may change appreciably. These tests are quite sensitive to the surface condition of the metal, and it appears that variations in the operation of the polishing machine, in the properties of the coated abrasive, or in characteristics of the metal surface may cause long-term changes in cleaning results. Consequently, it is necessary to run periodic cleaning tests with some reference cleaner solution to insure that cleaning level does not change during a series of comparisons. In this work, trisodium phosphate at 2 per cent Na_2O, and sodium carbonate at 8 per cent Na_2O have been used as reference electrocleaners, used anodically for 1 minute at 50 asf.

ELECTROCLEANING TEST RESULTS

Test results have been given in terms of residual soil on the steel discs, stated as micrograms. The conversion factors from counts per minute to micrograms were found by taking counts on known amounts of soil applied to the standard-polished steel discs with the soil applicator. With the particular counting geometry used, the stearic acid soil was found to give an average of 118 counts per minute per microgram, and the tagged oil (90 per cent No. 30 lubricating oil, 10 per cent radioheneicosane) was found to give an average of 59 counts per minute per microgram.

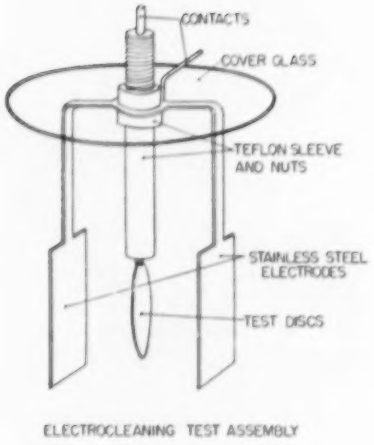
EFFECT OF CLEANING TIME

Anodic electrocleaning rates for solutions of some of the common alkalies are given in Fig. 4. The initial level of the stearic acid soil was 34 micrograms per steel disc. Indicated cleaning times were continuous, that is, soiled discs were not given multiple cleaning times to establish the curves.

These results show the effectiveness of the saponifying action of sodium hydroxide in removing this soil. Alkalinity, however, as expressed by *p*H is not the controlling factor, as metasilicate, with the second highest *p*H of these materials, is appreciably less effective than tetrasodium pyrophosphate (TSPP), which has a relatively low *p*H. Silicate ions seem to interfere in some way with the removal of thin films of stearic acid. It will be noted that there is a reversal in the relative evaluation of sodium carbonate and trisodium phosphate (TSP) with variation in cleaning time. Differences between the carbonate and TSP in this case are small, but the reversal shows how the choice of cleaning test conditions can affect relative evaluations.

EFFECT OF CONCENTRATION AND CURRENT DIRECTION

Effects of variation in concentration of the alkalies, used anodically and cathodically with stearic acid soil, are shown in Figs. 5, 6, 7, 8 and 9. The most notable effect here is the decrease in cleaning efficiency (rise in residual soil) with increase in concentration beyond a certain point. This effect was found also in the soak cleaning tests with stearic acid soil published previously.[3] With soak cleaning, however, the break in the curves with all the alkalies was found to occur between 1 and 2 per cent Na_2O in solution. With electrocleaning, the rise in the residual soil curve generally occurs at



ELECTROCLEANING TEST ASSEMBLY

Fig. 3. Assembly for electrocleaning tests. Used with a 500 ml stainless-steel beaker, not shown

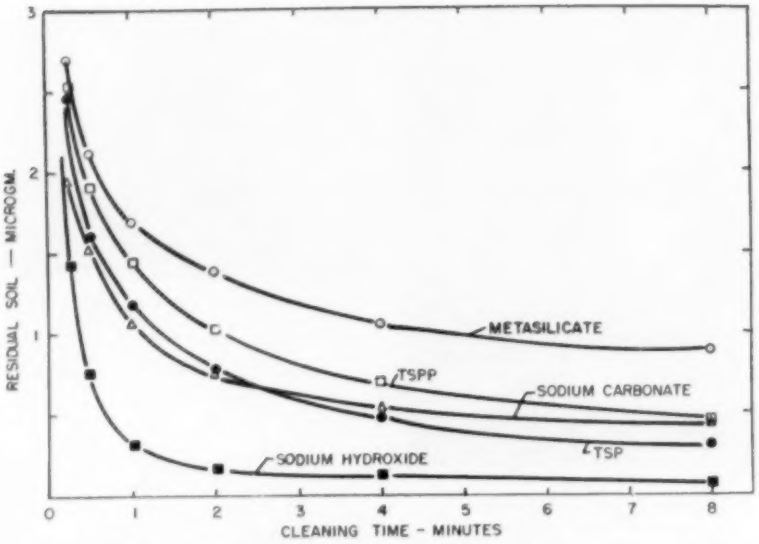


Fig. 4. Anodic electrocleaning rates with alkali solutions at 2 per cent Na_2O, showing residual stearic acid soil on steel with variation in cleaning time. Current density, 50 asf, temperature 90° C (194° F)

a higher concentration, varying with the alkali and the current direction.

Presumably, this concentration effect is related to the salting out of a soap at high ionic concentrations. Since soap concentrations resulting from saponification of stearic acid in these experiments would be extremely low in the bulk of the cleaning solution, there must be a film saturation immediately adjacent to the soiled metal surface. In electrocleaning, saturation occurs at a higher concentration, either because of agitation provided by released gases, or because of changes in ionic concentrations at the anode and cathode during electrolysis. The probable influence of film *p*H and ionic concentrations is indicated by the fact that the break in the curve generally occurs at lower concentration in cathodic cleaning than in anodic, although agitation presumably would be greater at the cathode because of the greater volume of gas evolved. Some further study of these effects may improve our knowledge of phenomena occurring at metal surfaces during electrocleaning.

With regard to anodic vs. cathodic cleaning, results varied with the alkalies. Sodium hydroxide and metasilicate were more effective anodically, and sodium carbonate and the phosphates were more effective cathodically. It so happens that the two alkalies that were most effective as anodic cleaners also are the most alkaline, but *p*H probably is not the controlling factor. Pyrophosphate and trisodium phosphate gave very similar results in relating anodic to cathodic cleaning, although they differ considerably in *p*H values.

EFFECT OF SURFACTANT

It has been found that addition of a small amount of anionic surfactant to alkali solutions counteracts the adverse effect of increasing concentration discussed above. When a constant 0.2 per cent of an alkylarylsulfonate is added to alkali solutions of varying concentrations, cleaning results are improved at all concentrations, and the curves equivalent to those shown in Figs. 5 through 9 are flattened, with no indication of rise in residual soil at higher concentrations. This is the case with either anodic or cathodic cleaning. Fig. 10 illustrates the effects of increasing additions of a sodium alkylarylsulfonate to a concentrated sodium carbonate solution used anodically and cathodically under fixed cleaning conditions. The solution of sodium carbonate containing 8 per cent Na_2O, when used alone, gives high residual soil levels in the rising portions of the curves shown in Fig. 6. Beneficial effect of the surfactant is pronounced, with reduction of residual soil levels below those obtained at lower, optimum concentrations with the alkali used alone. It will be noted that with surfactant present at the high alkali concentration, cathodic cleaning again becomes more effective than anodic.

EFFECT OF CURRENT DENSITY

In general, variation of current density over the range of 25 to 100 asf has a relatively minor effect on the removal of the stearic acid soil by alkalies and compounded electrocleaners. However, the effect of current density is interrelated with the adverse effect of high concentrations of alkalies discussed in previous sections. This concentration effect, giving rise in residual soil with increase in concentration, appears at lower concentrations in soak cleaning with a given alkaline solution than in electrocleaning. If an alkaline solution is being employed for electrocleaning at a concentration just below the rising portion of the concentration curve but above the concentration at which the rise occurs in soak cleaning, then, as current density is decreased the residual soil will show a pronounced rise. On the other hand, if the solution concentration is below the rising portion of the concentration curve for soak cleaning, or if the cleaner composition involved gives no rise in residual soil at high concentrations, then the effect of varying current density in the low range will be much less. This is illustrated in Fig. 11 with two different types of proprietary electrocleaners. Cleaner A shows only a small loss in cleaning efficiency with decreasing current density, whereas Cleaner B shows a very pronounced loss in cleaning efficiency (rising residual soil curve) with decrease in current density below 50 asf. Cleaner A at 8 oz/gal is within the optimum concentration range for either soak cleaning or electrocleaning, and decreasing current density, with transition from electrocleaning to soak cleaning conditions has little effect. Cleaner B, on the other hand, at 8 oz/gal is within the optimum concentration range for

electrocleaning at 50 asf, but it is well above the optimum range for soak cleaning. Consequently, with Cleaner B, decreasing current density with approach to soak cleaning conditions produces a rapid rise in residual soil. The effect shown in Fig. 11 has been found to have a practical importance. In practice, pieces sometimes are racked in such a way that current density on some areas is very low. With certain natural soils it has been found that compositions such as Cleaner B may give inadequate cleaning on such low current-density areas, whereas a composition such as Cleaner A will give satisfactory overall results.

EFFECT OF INITIAL STEARIC ACID SOIL LEVEL

The "standard" stearic acid soil used in most of this work was a very light soil by practical standards, being only 34 micrograms on a little over one square inch. The original selection of this low initial soil level was made partly because it was adequate for tracer evaluations, and partly because electrocleaning normally is used to remove the final traces of soil after preliminary cleaning by other methods. On this basis, use of a low initial soil level in electrocleaning studies can be justified, but it also is of interest to know whether relative evaluations of cleaners obtained at low soil levels also apply at higher soil levels. To provide some information on this point, electrocleaning tests were made with three initial soil levels: the "standard" stearic acid soil of 34 micrograms; 12 times this level, or 408 micrograms; and 24 times the standard level, or 816 micrograms. All other test conditions were fixed.

Results of four alkalies are given in Fig. 12, comparing residual soil values obtained after cleaning 1 minute, anodically at 50 asf. The most conspicuous result of increasing the initial stearic acid soil level is the reversal in results with metasilicate in comparison with TSP and sodium carbonate. The metasilicate is more effective than the other two alkalies in removing the bulk of a heavy stearic acid film, but less effective in taking off the last two micrograms. The reversal in this range of residual soil might be related to the fact that two micrograms of stearic acid is approximately the quantity that would be required to form a monomolecular layer on a smooth surface of the area involved here. On the other hand, the surface of the steel test pieces was by no means smooth on a micro scale, and radioautographs[3] of the residual soil on test pieces such as these have demonstrated that the stearic acid is not uniformly distributed. At low residual soil levels such as two or three micrograms, most of the stearic acid probably would be concentrated in the surface recesses. It is apparent from the results in Fig. 12 that average rates of soil removal are much greater with all the alkalies starting with the heavy soils than with the light. The last few micrograms come off much more slowly than the bulk of the stearic acid, and this may represent the increasing effect of surface roughness. It also might indicate some chemical reaction between the steel and the stearic acid.

COMPARISON OF TAGGED SOILS— MINERAL OIL AND STEARIC ACID

It must be kept in mind that the effect of cleaning variables on soil removal as illustrated in previous sections apply only to fatty acid soil, and the observations must not be applied too literally to the consideration of actual cleaning operations. It was found for instance that high alkali concentration generally gave no improvement in cleaning results over lower concentrations, and in some cases high concentration was quite detrimental in removing the stearic acid soil. In practice, however, it has been found desirable to use electro-

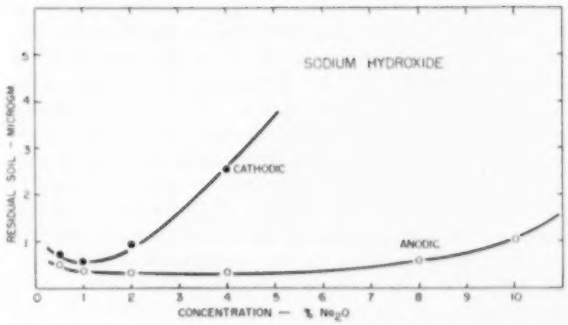


Fig. 5. Effect of alkali concentration in anodic and cathodic electrocleaning with sodium hydroxide solutions. Showing residual stearic-acid soil on steel after cleaning 1 min at 90° C (194° F) with current density of 50 asf

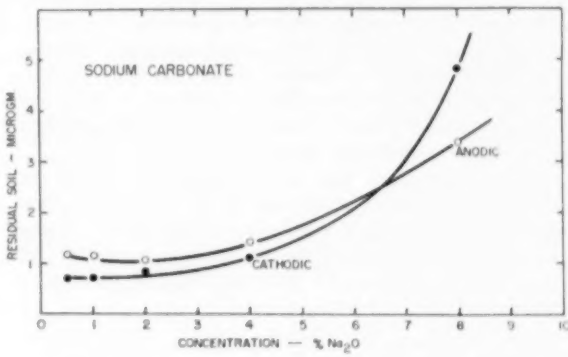


Fig. 6. (Same as 5 except with sodium carbonate solutions)

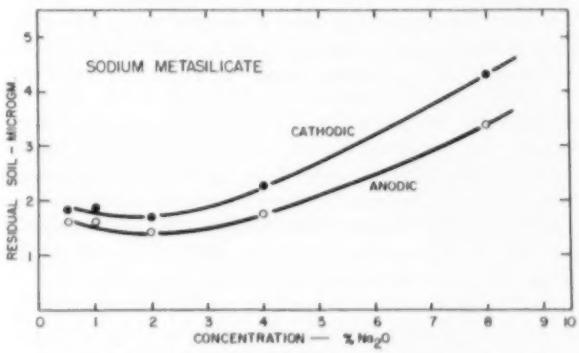


Fig. 7. (Same as 5 except with sodium metasilicate solutions)

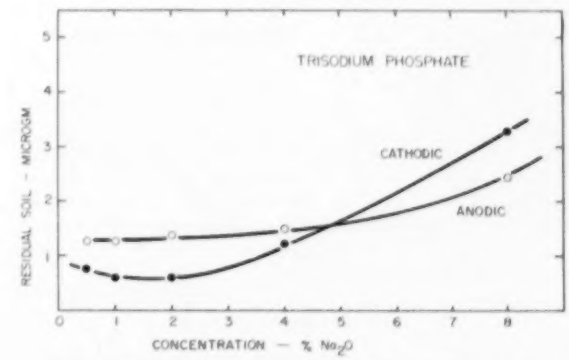


Fig. 8. (Same as 5 except with trisodium phosphate solutions)

cleaners at high concentrations, suggesting that removal of soil components other than fatty acid is improved by high concentrations. This was found to be the case with the tagged mineral-oil soil (No. 30 lubricating oil plus radiohenecicosane), as shown in Fig. 13. These curves compare residual soil values for stearic acid and for the mineral oil after one minute of anodic electrocleaning at 50 asf at concentrations of proprietary electrocleaner ranging from 2 to 16 oz/gal. The tests with the two soils were made with the same type of standard-polished steel discs. As evaluated with the stearic acid soil, there was a very slight decrease in cleaning efficiency with increase in concentration of the compounded cleaner. In contrast, with the mineral oil, there was a very pronounced improvement in cleaning results with increase in concentration.

As a further illustration of the differing behavior of soils, Fig. 14 shows the effect of varying current density in removal of stearic acid and mineral oil soils. With this particular proprietary electrocleaner, which was designated "Cleaner A" in Fig. 11, variation in current density has very little effect on the removal of stearic acid soil. In contrast, removal of the mineral oil soil showed a very pronounced improvement with increase of current density from 0 to 50 asf. A further increase to 100 asf had little effect.

It should be noted that the two soils, stearic acid and mineral oil, were used at different initial soil levels in these tests. Consequently, no conclusions regarding relative ease of removal can be drawn from the data as shown, although they serve to illustrate the differing effects of variation in cleaning conditions with the two soils.

DISCUSSION

The picture as given here of the electrocleaning process is necessarily an incomplete one, and interpretations of these experimental observations in terms of practical cleaning must be qualified by an understanding of the limitations involved in the studies so far. The need is apparent for further investigation of the effects of cleaning variables with various types of tagged soils. The effect of initial soil levels on relative evaluations should be studied further, and the influence of the metal surface finish on removal of various soils should be investigated. The basis metal involved is of obvious importance, and metals other than steel have been included in these tracer studies. It is expected that future publications will cover some of these variables more adequately.

Full use of the results of laboratory studies of metal cleaning requires adequate correlation with practical cleaning opera-

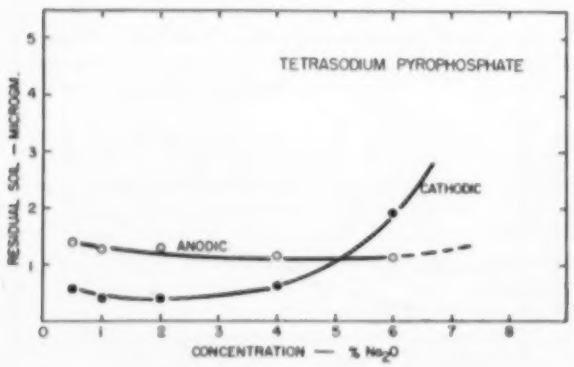


Fig. 9. (Same as 5 except with tetrasodium pyrophosphate solutions)

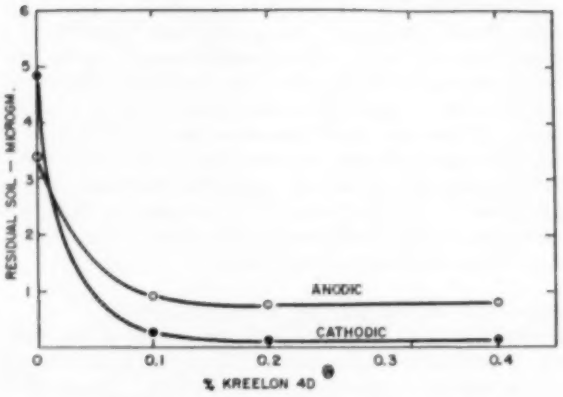


Fig. 10. Effect of anionic surfactant additions to alkali solution. Showing residual stearic-acid soil after anodic and cathodic electrocleaning for 1 min at 90° C (194° F) in solutions containing sodium carbonate at 8 per cent Na_2O and varying amounts of Kreelon 4D

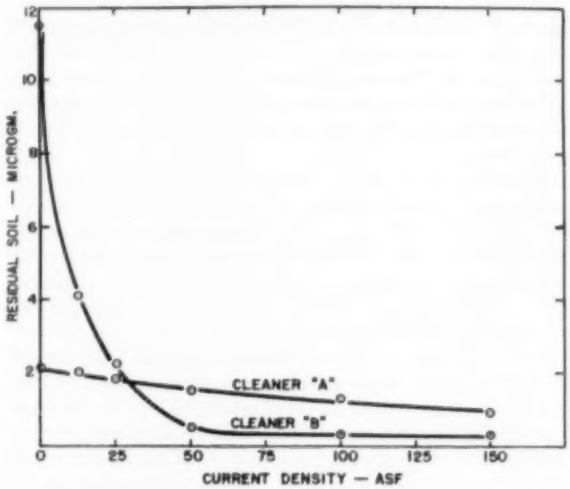


Fig. 11. Effect of current density with two different types of proprietary electrocleaners. Showing residual stearic-acid soil on steel after anodic electrocleaning for 1 min at 90° C (194° F) in 8 oz/gal solutions with variation in current density

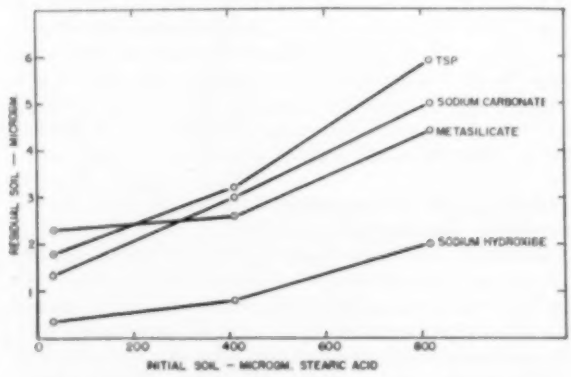


Fig. 12. Effect of initial soil level on relative evaluations. Showing residual stearic-acid soil on steel after anodic electrocleaning with various alkali solutions at 2 per cent Na_2O for 1 min at 90° C with 50 asf

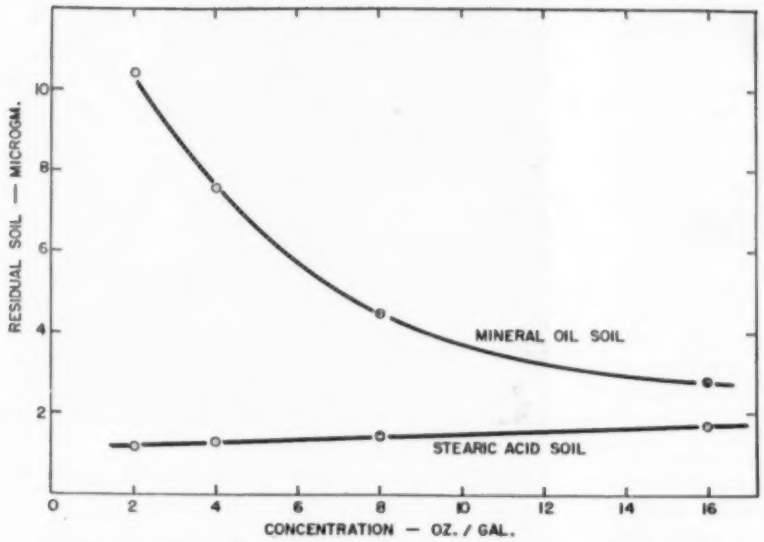


Fig. 13. Effect of concentration with different soils. Comparing residual mineral-oil and stearic-acid soils on steel after anodic electrocleaning for 1 min at 90° C (194° F) with 50 asf in a proprietary electrocleaner at varying concentrations

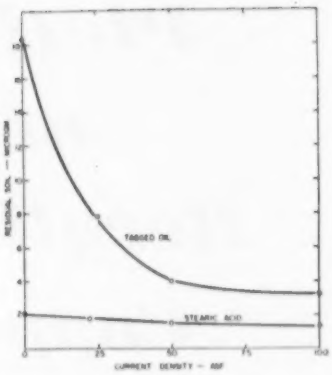


Fig. 14. Effect of current density with different soils. Comparing the effect of varying current density on residual mineral-oil and stearic-acid soils on steel after anodic electrocleaning for 1 min at 90° C (194° F) in a proprietary electrocleaner at 8 oz/gal

tions. Some correlation can be established by interpretation of observed experimental results in terms of practical metal cleaning experience. On this basis, it is known that the pronounced concentration effect and the interrelated current density effect observed in some cases in removal of the tagged stearic acid from steel can have a practical significance. However, the need is apparent for further controlled plant-scale studies to provide information for correlation with laboratory investigations.

It is felt that with continued investigations such as these with tagged soils, our knowledge of the electrocleaning process should be improved sufficiently to result in more efficient electrocleaning compositions and processes. In addition to their use in studying cleaning processes, these tests with tagged soils should have a broader usefulness. They are proving of use in screening tests in formulation work. We also believe that one or more of the tagged soils may be adapted to use as a control method in plant cleaning operations. The great sensitivity of the tracer cleaning test when properly employed may serve to provide data anticipating the need for additions to or change of a cleaning bath before such need becomes apparent from the appearance of rejects in a line. This would involve routine, controlled testing in the bath with standard-soiled panels. This possibility is being investigated.

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Hensley

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Ring

Plating of Beryllium Copper*

By S. J. MORANA†

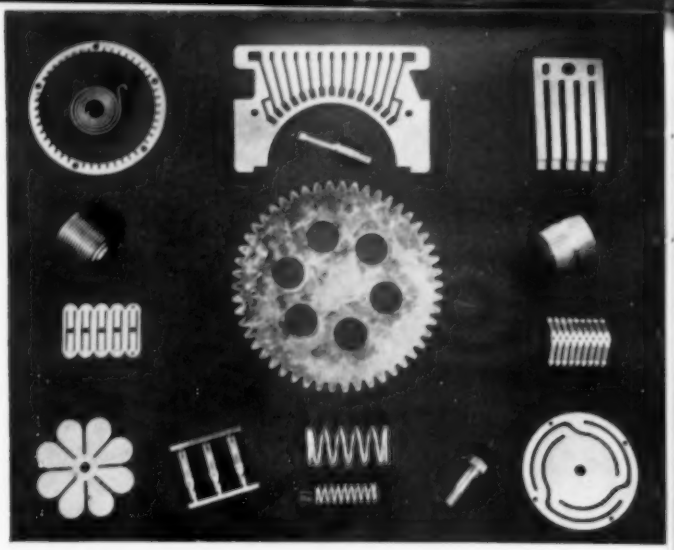


Figure 1
Miscellaneous beryllium copper parts, illustrating versatility of uses

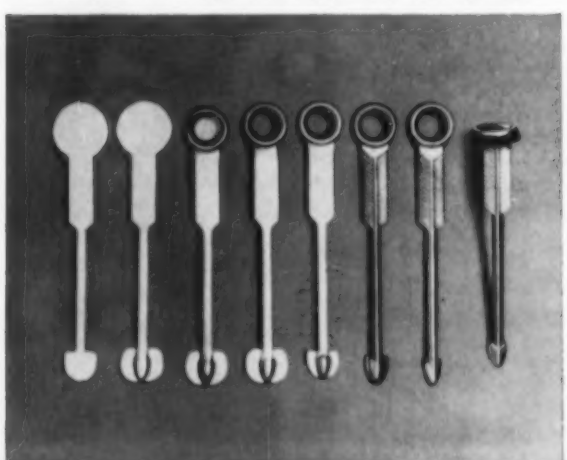
INTRODUCTION

Many are perhaps not fully aware of the treatment of beryllium copper alloys prior to the plating operation, therefore, a brief outline will be given of some of their interesting properties and why they are used in many instances in place of brass, bronze or other copper base alloys.

Beryllium copper alloys are finding increasing usage in countless applications in the automotive, electrical, and other industries because of their unusually important physical and mechanical properties. These alloys have the ability to be hardened by a simple heat treating operation from a relatively soft and workable state to levels of strength and hardness beyond those of other copper-base alloys. The strengths of the final product can be varied over a large range merely by varying the time and temperature of the heat treating operation.

Beryllium copper is offered to the fabricators in a variety of tempers to meet different applications. For example, in the fully annealed condition the alloy is soft, and lends itself readily to severe forming operations such as in the preparation of bellows, etc. to permit the most exacting requirements of product designers. Instruments and controls rely heavily upon the precise action of beryllium copper diaphragms, bellows, and springs. Problems of fabrication and service relative to production of some electronic devices could not be solved without beryllium copper. Besides being readily blanked, formed, deep drawn, or spun, beryllium copper also possesses the outstanding property of being unusually resistant to fatigue. Fatigue is the tendency of a metal to fracture when subject to a cycle of alternate tension and compression. Beryllium copper also offers excellent resistance to fatigue under vibration when other high copper base alloys show indications of early failure. This, coupled with its good electrical conductivity, high strength, and spring-back properties make beryllium copper invaluable for use in electrical and electronic contacts, compression springs, etc. A few of these applications are illustrated in Figure 1.

Figure 2
Successive blanking, piercing, drawing, and bending operations are required in the production of fountain pen pocket clips. Such parts are usually finished by gold or rhodium plating



Beryllium copper alloys are also supplied in quarter-hard, half-hard, or hard condition to conform to the desired application. For a straight blanking operation it is more desirable to obtain the strip in a quarter-hard or half-hard condition rather than in the solution annealed soft condition. Beryllium copper alloys are supplied in different forms such as rod, wire, strip, bars, etc. to meet the particular needs of various applications.

After the product is formed from a soft or semi-soft condition it is then given the desired strength and hardness properties by heat-treating at 600–700° F for 1–3 hours depending on the particular alloy used and the physical properties desired. From the viewpoint of the electroplater the main distinguishing difference between plating on beryllium copper and plating on other copper base alloys such as brass or phosphor bronze is that parts made from beryllium copper alloys generally have to be heat-treated to attain their maximum properties. In the process of heat-treating, beryllium copper is subjected to temperatures of 600–700° F, at which time it experiences surface oxidation. This is especially noticeable when the articles are heat-treated in an air circulating furnace, where the articles come out with a gray-black coating covering its surface. This surface coating consists of both cupric (black) and cuprous (red) oxides, and must be completely removed prior to plating.

As with other metals, electroplating on beryllium copper has the express purpose of altering its surface properties. Its beneficial results may include improved electrical properties; improved resistance to corrosion, tarnish, chemical attacks,

*Presented at the 42nd Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

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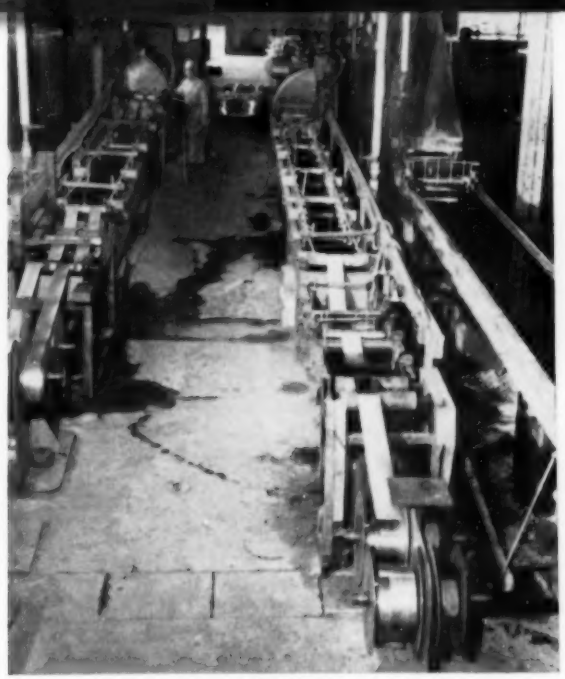


Figure 3
A view showing two continuous beryllium copper strip cadmium plating units in operation. This is the inlet end of the units

and wear; increased hardness; die lubrication; improved frictional and nongalling behavior; and improved appearance. The great bulk of beryllium copper parts are generally plated for improved surface electrical properties (silver), as a die lubricant (cadmium), and for resistance to corrosion from plastics or rubber (hard chromium).

Some beryllium copper parts such as fountain pen pocket clips, shown in Figure 2, are usually gold or rhodium plated for appearance. Rhodium is also used for unusual combinations of corrosion and wear resistance, hardness, and reflectivity. Where service requirements demand a white surface, either tin, nickel, or chromium plating may be applied, the final selection between these metals depending upon economy and the corrodants present. A tin or nickel plate is of advantage in soft soldering, as they permit the use of noncorrosive rosin fluxes. Tin, zinc, or cadmium plates may be used to compensate for differences in electrochemical potential at bimetallic junctions.

Silver is sometimes plated onto beryllium copper wire to function as a die lubricant in the drawing operation. It further serves to protect the surface from oxidation during subsequent annealing and heat treating operations.

To give you some idea of the magnitude of electroplated beryllium copper, it is estimated that 60,000 pounds of beryllium copper is electroplated monthly. Taking into account that a sizeable proportion of this material is used to prepare very small contacts for electronic and electrical devices, it is readily apparent that the actual number of component parts electroplated per month is quite high. It is anticipated that the tonnage of electroplated beryllium copper will show a moderate rise in the next few years.

PREPARATION OF METAL SURFACE

Electroplating involves more than just placing an object into a plating bath. Before a metal can be electroplated, the surface must be properly prepared; that is, it must be physically, chemically, and mechanically clean. Too often the novice as well as even the experienced plater does not recognize the importance of these requirements. A plated coat will peel off readily when plated onto an unclean surface.

Before plating beryllium copper parts it is necessary to insure that the metal is (1) free from oils, greases, and superficial dusts, (2) free from burrs and loose fragments produced by mechanical operations, (3) free from oxides or other surface-formed compounds of the basis metal which form during heat treating, or on standing in humid or corrosive atmospheres.

Oil, grease, or dirt can be removed with vaporized solvents or alkaline cleaning solutions. A good example of the former is trichloroethylene or other vaporized solvents which form condensates and wash away oily coatings. Examples of alkaline cleaning solutions are sodium carbonate, trisodium phosphate, sodium metasilicate, and various combinations of these or similar materials. Burrs and loose fragments can be removed from small parts by barrel tumbling, with time dependent upon the edge or finish required.

HEAT TREAT AND PICKLING

The oxide scale which forms on beryllium copper when heated in an uncontrolled atmosphere can be removed by pickling. As was indicated above, beryllium copper alloys after being formed from a soft or semi-soft condition are generally imparted desired strength and hardness properties by heat treating at 600–700° F for 1–3 hours, depending on the particular alloy used and the physical properties desired. Parts should be carefully degreased before heating.

The greatest amount of surface oxidation occurs by heat treating in an air circulating furnace, or in an uncontrolled atmosphere muffle furnace. Because the heating rate is slower in a muffle furnace, hardening will require a longer time than in a circulating air furnace. In either method the metal comes out with a gray-black surface interspersed with red spots. The black oxidation product is cupric oxide which is easily removed by pickling in hot sulfuric acid. The red oxidation product is cuprous oxide and is difficult to remove without oxidizing it to the cupric state. Consequently, the sulfuric acid treatment is followed by an oxidizing dip such as a potassium dichromate-sulfuric acid dip in which the cuprous oxide is oxidized to the cupric state, and all traces of black scale and red stains are thereby removed.

One pickling procedure involves the use of 20–30 per cent by volume of sulfuric acid and water at 160–180° F, sufficient immersion time being allowed to completely loosen the dark scale. This is followed by a brief dip in a 30 per cent by volume cold solution of nitric acid and water to remove all traces of oxide coating. Immersion time, which is limited to prevent etching the base metal, is best determined by trial.

Acid stains may result unless parts are carefully cleansed of all acid. Thorough rinsing with cold water between successive acid treatments, followed by hot rinsing, are necessary to remove all traces of acid. An acid-neutralizing dip in trisodium phosphate or similar alkaline solution is sometimes desirable between final cold and hot water rinses to avoid any possible acid stain.

When articles prepared from very thin gage beryllium copper strip such as 0.005 inch or under are pickled after heat treating, care must be exercised not to etch the surface too deeply. Severe pickling on these thin parts will cause pitting and undersize gages. For this reason some platers have found a single pickling treatment in proprietary compounds, such as ebonol compounds, effectively removes all traces of oxide coating. In order to minimize the oxide scale formation on the surface of beryllium copper parts during heat treating, it is advantageous to reduce contact with air as much as possible during heating. Experience has shown that by heat treating in a reducing atmosphere the beryllium copper parts maintain

their luster and exhibit only a trace of surface oxidation. The controlled atmosphere heat treating is done, for example, in an enclosed container about 2½ feet diameter by 3 feet high in which a safe atmosphere of 90 per cent nitrogen and 10 per cent hydrogen is bled in. The whole container is placed inside an appropriate controlled furnace for specified time intervals. An air circulating fan is placed inside the container to better obtain uniform circulation.

Another procedure commonly used for heat treating beryllium copper parts where a lesser oxide surface coat is desired is by using a salt bath. Salt baths, by giving faster heat transfer, require 25–50 per cent less total time than a circulating air furnace. The rapid and uniform heating of salt baths gives good results at any temperature in the hardening range of beryllium copper. Commercially available nitrate-nitrite mixtures (40–50 per cent sodium nitrite, balance sodium or potassium nitrate) which melt at about 290° F are generally used. Baths for beryllium copper should be kept clean and not used for other materials such as steel. After removal from the bath, parts should be carefully cleansed of all traces of salt by quenching in water. With the salt bath procedure the beryllium copper parts are completely surrounded by fused salt during the complete heating cycle, thus minimizing tendency to oxidation.

When parts which have been formed from cadmium coated beryllium copper are to be heat treated and electroplated, it has been found advantageous to heat treat the parts, either in the air circulating furnace or in a salt bath, with the cadmium coating left on. The cadmium coat offers protection to the base metal from surface oxidation during heating. In so doing, the pickling operation for stripping the cadmium prior to heat treating is eliminated, and the subsequent pickling to remove surface oxidation after heat treating is considerably minimized. When heating beryllium copper parts coated with cadmium, care must be taken to properly ventilate all exhaust fumes, because cadmium is considered quite toxic.

In summary, from the viewpoint of ease of pickling following the heat treating operation, it is most desirable to heat treat in a controlled reducing atmosphere furnace. Next best, and probably more practical to set up, is the use of an appropriate salt bath. With either of these methods the surface oxidation is reduced to a minimum. The subsequent pickling operation is less severe, with a corresponding diminished etching on the metal surfaces to be plated.

BRIEF REVIEW OF ELECTROPLATING PRINCIPLES

As a general statement, it may be said that electroplating on a clean beryllium copper surface is no different than plating onto copper, or brass, or other copper base alloys. The various basic factors that affect the nature of the deposit is the same in each case. Electrodeposited metals, like all other metals, are crystalline in character, and the appearance and physical properties of the deposit are produced by differences in the size or shape of the crystals. The character of the deposits are governed to a large extent by the proper control of a number of variables, the more important of which are:

1. CURRENT DENSITY

Increase of current density, within limits, will yield deposits that are more fine-grained. Increasing the current density above certain limits causes formation of "trees" or nodules.

2. CONCENTRATION AND AGITATION OF ELECTROLYTE

By increasing the concentration of the solution, or by the use of agitation, it is possible to postpone until much higher currents the harmful effects such as burnt or spongy deposits accompanying the use of high current densities.

3. ADDITION AGENTS

The presence of quite small amounts of certain organic substances, or of colloidal matter, surprisingly produce smooth, fine-grained, and microcrystalline deposits. Most commercial formulations today incorporate the correct amounts of addition agents in the composition.

4. NATURE OF THE ELECTROLYTE

The type of electrolyte used often has a very profound effect on the appearance of the deposit. For example, silver deposits coarse from nitrate baths, but forms a fine-grained deposit with cyanide baths.

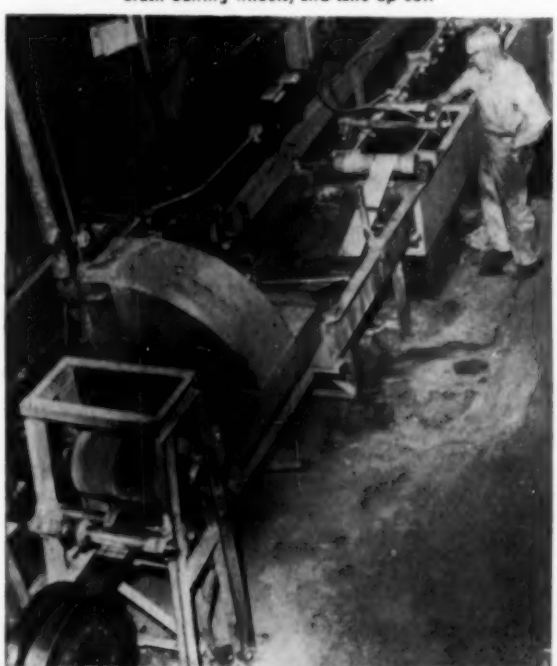
Each of the many operating variables independently influences the plate in some manner, and all function interdependently.

CADMIUM PLATING OF MILL PRODUCTS

The great bulk of beryllium copper parts to be electroplated are stamped or drawn from thin sheets which are generally electroplated with a cadmium coating of 0.0001–0.0004 inch thick as a die lubricant in pressworking to enhance punch and die life. One of the electroplating operations carried on at the Beryllium Corporation in Reading, Pennsylvania involves the continuous cadmium plating of beryllium copper strip. The strip ranges in size from 1–5 inches wide and 0.003–0.050 inch thick. These are rolled into coils weighing up to 200 pounds each. Since the function of the cadmium coating is to act as a die lubricant, the coils are electroplated from a fully annealed or cold rolled condition, and sometimes in a mill hardened condition. The temper of the metal depends, of course, on its end use.

Prior to cadmium plating, the coils are pickled by soaking in hot sulfuric acid (about 180° F), then given a bright dip in cold nitric acid, followed by a bright dip in a cold sulfuric acid-sodium dichromate solution. The coils are thoroughly rinsed with cold water after each acid treatment, finally with hot water followed by forced air for drying.

Figure 4
A view of the outlet end of a strip cadmium plating operation illustrating the final water rinse, hot-air drying cabinet, rotary brush buffing wheels, and take-up coil



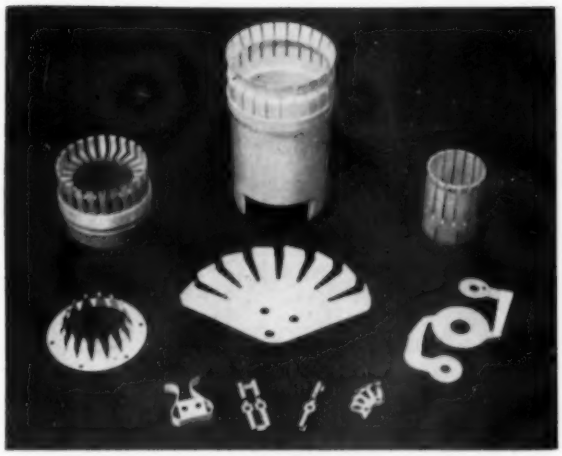


Figure 5
Assortment of beryllium copper components that have been silver plated. They are used in electronic applications

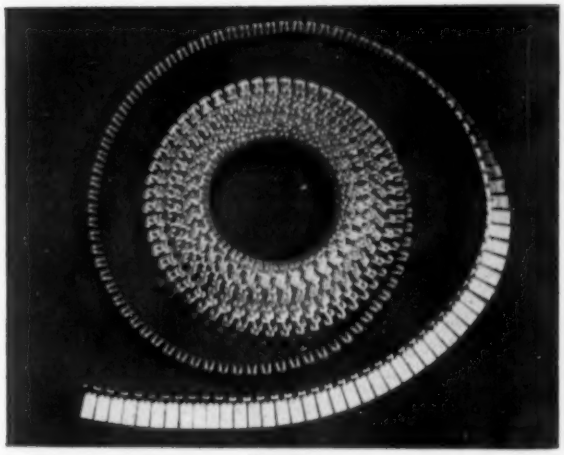


Figure 6
A coiled beryllium copper strip expander designed to overcome packing leakage in pumps, etc. by exerting a controlled mechanical pressure on the lip of the packing

The beryllium copper strip is being continually uncoiled on one end of the electrolysis unit, then fed respectively through a dilute nitric acid solution, a spray water rinse, the electroplating tank, a second spray rinse, a hot air drying cabinet, and finally the surface is buffed by passing the strip through rotary brushes before coiling the finished strip. In order to keep the electrolysis unit functioning in a continuous manner, the end of a coil being fed in is soldered to the beginning of the next coil. Each plating cell is 20 feet long x 18 inches wide x 18 inches deep, and is set up to electroplate two beryllium copper strips simultaneously. The two strips are run through the bath side by side. The Udylite process is used by the author's company in cadmium plating. In this process cadmium ball anodes are placed in heavy helical coil containers, offering a simple method of renewing anodes. New balls are inserted at the top as the original balls dissolve in the solution and drop lower in the container. In this way the anodic surface area remains practically constant. The cadmium content is maintained at 2.5–3.0 oz/gal, free sodium cyanide at 9–11 oz/gal, and caustic at a minimum of 1 oz/gal. A view of this unit is shown in Figures 3 and 4.

In the normal process of drawing beryllium copper rod and wire, commercially available oil or drawing compounds provide sufficient lubrication. During severe reductions the drawing compounds are not sufficient to keep the metal from picking up in the die. For use in the severe drawing operation cadmium plating forms a soft metallic surface coating which acts as a die lubricant during drawing. Beryllium copper rods as large as 2½ inch diameter are coated with 0.0008–0.001 inch of cadmium electroplate for this purpose in a cyanide electroplating bath. In this bath the cadmium content is replenished by adding cadmium oxide and sodium cyanide as needed to maintain the composition within limits. Since the cadmium coating is only functional and not decorative, no brighteners or other addition agents are employed.

SILVER PLATING OF FINISHED PARTS

A large proportion of beryllium copper finished parts are used as electrical contacts of some form or other in electrical and electronic devices. Where improved electrical characteristics such as improved surface conductivity, low contact resistance, and high frequency conductance are required, it is generally desirable to plate with such noble metals as silver, gold, or rhodium. Of these metals, silver is the most widely used. Figure 5 illustrates several varied beryllium copper contacts that have been silver plated. Since the surface condition of the material entering the plating bath exerts the greatest influence on the final result, it is essential that parts be absolutely clean and free from oxide, oil, grease, and dirt. Where chromic acid or dichromate pickling solutions may have preceded plating, it is desirable to remove the thin oxide film formed thereon by a cold 30 per cent nitric acid bath prior to plating in order to insure good adherence of the plate.

Because silver is near the lower end of the electromotive series, difficulty is experienced in plating it on metals above it in the series. For this reason silver deposits by contact, with a tendency to form a poorly adhering deposit. All commercial silver-plating solutions are cyanide solutions with considerable free cyanide, because it has been demonstrated that the potential of silver can be made more negative by having free cyanide present. Since copper is only slightly above silver in the electromotive series the effect of potential difference is practically eliminated, especially with the cyanide baths.

It is customary to use two baths for silver plating, a "strike" solution and a "plating" solution. The articles are first placed in the strike bath for about 10–20 seconds in which time a very thin coating of silver is formed on the surface in order to obtain good adherence of the final silver plate. The strike solution has a very low silver concentration and a very high free cyanide content as compared to the regular plating solution. The current density in the strike bath is around 12 amp/sq ft. Some electroplaters prefer to apply a strike coat of copper on beryllium copper parts in place of the silver strike prior to the silver plating, but the majority of platers use the more conventional silver strike.

Plating conditions conventionally used for electroplating on copper, brass, etc. apply for the plating on beryllium copper parts. These include the selection of purest obtainable silver anode to avoid a blackish surface discoloration, maintaining free cyanide composition and anode current density within the prescribed limits, etc. As is usually the case, care must be taken to make sure that the current is turned on in the tank before introducing the parts to be electroplated. The commercially available silver "Lume" solution* is practically universally used for silver plating onto beryllium copper. It

*Prepared by Hanson-Van Winkle-Munning Corp.

gives a desirable bright finish on beryllium-copper parts without buffing. The current density used is around 8 amp/sq ft.

Smaller parts are electroplated using standard barrel plating techniques. Some producers of beryllium copper parts stamp out the small parts from beryllium copper strip so that each unit is interconnected with the next, and the individual components are later cut apart after plating. Figure 6 illustrates a coil of interconnected stamped pieces prior to electroplating. These stamped strips are rolled loosely onto a spool, and the spools are heat treated, pickled, and electroplated as a unit. One technique used is to deposit about half of the desired electroplated silver thickness onto the spool which is wholly immersed in the plating bath. The spool is then removed from the bath, water washed, recoiled backward onto an empty spool, and the deposition of the desired silver thickness is completed. The individual parts all have a uniform silver coating on them and are cut into individual parts after plating. This technique has the advantage in that larger amounts of parts can be electroplated and washed with a minimum of handling.

CHROMIUM PLATING OF PLASTIC MOLD DIES

Beryllium copper is finding increasing application as a mold material in both injection and compression molding of industrial and novelty plastic components, such as toy dolls, toy cars, automobile emblems, control dials, pocket combs, figurines, etc. With improved casting procedures such as pressure casting, molds with accurate reproduction of intricate detail and design can be cast without requiring further expensive machining and polishing. The resulting beryllium-copper cavities are shock resistant and extremely strong, with uniform hardness and density. When given a reasonable amount of care, beryllium copper cavities give service from a die-wear standpoint equal to that of hardened steel.

Figure 7 illustrates a diversified group of beryllium copper pressure castings, showing the sharp detail that can be achieved.

These beryllium copper mold cavities are corroded by certain types of plastics, especially in compression molding. For best results, hard chrome plated mold surfaces are recommended for use with certain phenolic or vinyl plastics. A flash chromium plate 0.0003 to 0.0005 inch thick is usually applied to the surface after the cavities and cores have been properly hardened and pickled.

Although the many theories offered for the mechanism involved in the deposition of chromium from chromic acid solutions are not in complete agreement, the fact remains that considerable hydrogen is generated in the process. One advantage of chromium plating onto beryllium copper surfaces is that although there is some slight amount of hydrogen embrittlement noted on other high-copper alloys such as hard bronze, no one has yet evidenced any hydrogen embrittlement on beryllium copper.

The throwing power of chromium plating baths is very poor as compared to other metals. Because of this, insoluble lead alloy anodes are made to roughly conform to the complex shape of the mold, and are employed in the plating operation of irregular shapes in order to apply a uniform chromium coating.

Although the chromium to be deposited is introduced into the plating bath as the chemical chromic anhydride (CrO_3), commonly called chromic acid, all chromium plating baths require the presence of acid radicals such as sulfate to act as "catalysts." These acid radicals permit the plating of chromium without themselves being consumed by the reaction. The amount of acid catalyst added is extremely important. Too low a catalyst concentration will result in no plating and too high a catalyst content will give poor throwing power. For best results the weight ratio chromic acid to sulfate should be about 100:1. Either sulfuric acid (H_2SO_4) or anhydrous sodium sulfate (Na_2SO_4) can be used to supply the sulfate catalyst to a chromium plating bath.

The following composition has been successfully used for chromium plating of the hard or industrial type onto beryllium copper:

Chromic acid (CrO_3)	30–50 oz/gal
Sulfuric acid (H_2SO_4)	0.3–0.5 oz/gal
Temperature	100 to 160° F
Current density	150 to 300 amp/sq ft

Self-regulating, high-speed chromium baths which operate on the principle of self-regulation of the catalyst content by means of the solubility characteristics of the special addition agents used, are sometimes used for electroplating onto beryllium copper. This is especially used on parts where the chromium serves as a decorative effect. In addition to the self-regulating feature, these baths have reputed advantages in speed, hardness, brightness, smoothness, adhesion, plating range, and covering power over the other solutions. These baths are found to be easier to regulate and maintain, and material can be replaced into the bath and still continue to deposit bright.

In summary, it can be briefly stated that after beryllium copper parts are properly cleaned and pickled following the heat treating operation to impart their desired physical properties, they can be readily plated with other metals such as cadmium, silver, chromium, zinc, nickel, etc. by the usual methods. It must be stressed that success of the plating depends upon a thorough cleaning of the part prior to immersion in the plating bath.

SIMON J. MORANA

Morana

Simon J. Morana was born in St. Louis, Mo. on April 22, 1917. He received his B.S. degree in 1941 from Western Reserve University and a M.S. degree from Duke University in 1942.

From 1942 to 1947 he was associated with the Beacon Research Laboratory as Research Chemist, and from 1947 to 1952 did classified research on high-purity beryllium metal under AEC sponsorship. Morana has been with The Beryllium Corporation as Research Engineering Chief since 1952.

Figure 7
A diversified group of beryllium copper cavities and cores produced by pressure casting methods, illustrating the wide range of application and fidelity of reproduction possible with beryllium copper. (Courtesy of Manco Products, Inc.)

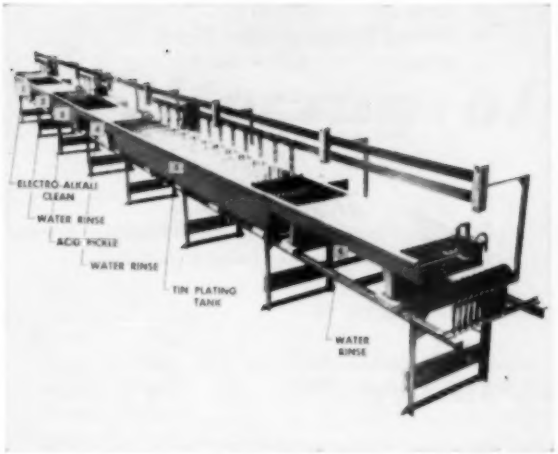


Figure 1
Typical Wire Plating Line Developed for Use with Stannous Fluoborate Bath

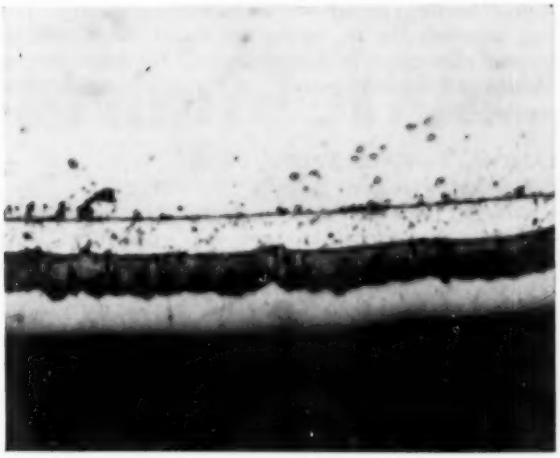


Figure 2
A Layer of 0.00015 inch of Tin on a No. 14 Copper Wire

ELECTROTINNING OF COPPER WIRE FROM THE STANNOUS FLUOBORATE BATH*

By A. E. CARLSON†

In recent years considerable interest has been shown in the electrotinning of copper wire as a substitute for the hot dip process. Plating has been found to give more uniform deposits with closer control of thickness, thereby affording considerable savings of tin. For example, coating final wire sizes by the hot dip process results in thicknesses of about eighty to one hundred millionths of an inch, which is heavier than necessary, while electroplating can produce deposits of any order of thickness. Twenty to thirty millionths of an inch usually is sufficient. This control of thickness represents a saving of approximately two-thirds of the tin.

PROCESS AND EQUIPMENT

Figure 1 shows a typical wire plating line that was developed for use with the stannous fluoborate bath. Other features may be incorporated in new designs or other wire plating lines may be converted for use with fluoborate solutions. The line consists of the following steps in processing the wire as it passes from left to right:

TANK No. 1—ELECTROALKALI CLEAN

This is a steel or stainless steel tank, 6–8 feet long, including overflow sections at either end. The alkali solution is heated to 200–212° F in a storage tank attached to the cleaner tank and circulated by a deep well-type pump so it flows over the slotted Lucite dams at the ends of the tank and back to storage. Sodium cyanide at 1 oz/gal may be added to the solution to facilitate cleaning. The wire is made the anode and the tray in the tank the cathode.

TANK No. 2—WATER RINSE

This is a stainless steel tank 6–8 feet long including overflow sections at either end, and contains a tray with cypress or redwood strips, 1½ inches high by one inch thick, bolted to it thus providing troughs through which the wire travels countercurrent to jets of water which overflows through slotted Lucite dams and then to the sewer.

TANK No. 3—ACID PICKLE

This is a steel or stainless steel tank, lined with rubber or Koroseal, 6–8 feet long including overflow sections at either end. Should it be desired to make the acid an electropickle, a 2.5 per cent fluoboric acid solution is employed, making the wire the anode and the carbon plates in the rubber covered holding tray the cathode. If the acid is to be used merely as a soak pickle, a concentration of around 10 per cent fluoboric acid is employed. The circulation of this tank is the same as the electro-alkali cleaner.

TANK No. 4—WATER RINSE

This tank is the same as No. 2.

TANK No. 5—TIN PLATING

This tank is 14 feet long including overflow troughs at either end and may be of steel or stainless steel lined with rubber or Koroseal. The storage tank is attached and is equipped with a deep well-type pump to circulate the bath. Slotted Lucite dams are placed at either end to maintain

*Presented at the 42nd Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

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solution level and permit overflow to return to storage. The tray on which the tin anodes are placed should also be covered with rubber or Koroseal, except the inside portion which makes electrical contact. A heater is installed in the storage section.

TANK No. 6—WATER RINSE

This tank is the same as No. 2.

Following each of the above tanks, are provisions for wiping the wire with air and/or dies. These prevent "drag out" and "drag in" from one tank to another. The most important are those before and after the tin plating tank, inasmuch as economy of operation is obtained by keeping the loss of plating solution to a minimum. Diamond dies set in Lucite, having a diameter of 0.0005 inch greater than the wire, following each tank have been employed for this purpose.

If desired, the plated wire may be brightened by burnishing through a die 0.0005 inch smaller than the wire after leaving the last water rinse.

Wires up to No. 24 may be processed as outlined above. When finer wires such as No. 34 are desired, heavier gauges of No. 12 to No. 20 should be plated with heavier deposits of tin and subsequently drawn to the final size and annealed.

As regards electrical contacts, the system may be operated by completing the circuit through the cathode in the alkali and acid tanks where the wire is positive, and through the anodes in the plating tank where the wire is negative. In this manner, no direct contacts on the wire are required. However, experience has shown that when plating heavy tin deposits, on the order of 0.0001 inch thick on a No. 20 wire, it is advisable to install roller type electrical contacts on the alkali tank and tin tank, using the 10 per cent fluoboric acid as the soak pickle.

The above line including storage tanks for alkali, acid and tin plating units is about 3 feet wide, 1½ feet deep and 44–46 feet long. The water rinse tanks are 22 inches wide by 10 inches deep. No water storage tanks are required since the rinse waters are passed to the sewer.

In cases where wire needs more thorough cleaning, the alkali and acid pickle tanks may be increased in length. Also the tin plating tank may be divided to allow additional electrical contacts and increased in length.

The above line will process 10 wires at a time, on 2-inch centers.

All tanks, except the water rinses, are provided with slotted Lucite separators to prevent whipping of the wire when traveling through the line.

SPEEDS OF PLATING

The following table will give some idea of the possible speeds and current densities:

	Size Wire No.		
	14	20	20
Diameter, Inches	0.06408	0.03196	0.03196
Plating Length, Feet	12	12	12
Area, Square Feet	0.02010	0.1002	0.1002
Ft/min	500	500	350
Amp/Wire	117	58.6	133
Amp/sq ft	583	583	1350
Tin Thickness, Inches	0.00003	0.00003	0.0001

Formulas for calculating speeds, current density, etc. are as follows:

1. Amp/Wire = 0.122 dTS
2. Current Density = 0.466 TS ÷ L
3. Area in sq ft = 0.2618 dL

d = Diameter in inches
T = Thickness of tin in millionths of an inch
S = Speed of wire in ft/min
L = Effective tank length in feet

BATH MAKE-UP

The following plating solution, prepared from the stannous fluoborate concentrate, has been found suitable.

BATH COMPOSITION

	g/l	oz/gal
Stannous Fluoborate ($Sn(BF_4)_2$)	200	26.8
Free Fluoboric Acid (HBF_4)	200	26.8
Tin (Sn)	81	10.8
Gelatin	3	0.4
Beta Naphthol	0.5	0.065
Catechol	0.5	0.065

ANODES

Pure cast tin anodes are recommended.

The above addition agents (gelatin and beta naphthol) are controlled by observing the condition of the deposit. If loose tin is noted, then additional quantities of these materials should be added. In practice, a schedule of additions may be worked out so that they can be made at regular intervals. A guide on frequency of additions may be established by use of test panels plated in a Hull cell.

The addition of catechol will minimize the oxidation of stannous to stannic tin. The frequency of addition can best be controlled by determining the stannic tin by chemical analysis.

The high free fluoboric acid assists in anode corrosion and promotes stability of the bath.

When plating heavy thicknesses of tin it will be found necessary to increase the tin concentration to 110–120 g/l.

CROSS SECTION OF WIRE

Figure 2 shows a layer of 0.00015 inch of tin on a No. 14 copper wire. This is the third layer from the top. The other layers are nickel and copper to reinforce the tin layer to prevent it from dislodging during the polishing operation.

CONCLUSION

Because of their stability, high-speed characteristics and simplicity of operation, other fluoborate plating chemicals are finding use in the wire industry. For example, copper fluoborate is employed in the plating of steel wire for the telephone industry and lead fluoborate for coating of stainless steel wire prior to drawing.

Carlson

A. E. CARLSON

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He is employed by General Chemical Division, Allied Chemical & Dye Corporation from 1922 to date as Analyst, Research Chemist and Electro-Chemist. Carlson is a member of the New York Branch, AES.

Filtering of Chromic Acid Solutions*

By R. F. LEDFORD† and L. O. GILBERT‡

INTRODUCTION

In the transition of electroplating from an art to a science, filtration has become necessary for the optimum performance of most processes. Not too long ago, filtration was used only at irregular intervals while today, continuous filtration is the rule rather than the exception.

The acceptance of filtration is undoubtedly the result of understanding the effect of many contaminants upon the physical properties of the deposits or upon the operation of the process. Today, the emphasis is on maintaining electrolytes of the highest purity. The relative simplicity of the chromic acid plating solution has detracted from the importance of filtering and, in some cases, purifying such solutions. In this paper, the operation and construction of filtration equipment, as well as several applications where filtration is helpful, will be covered.

FILTRATION ANALYSIS

In its simplest form, filtration is merely the separation of solids from liquids by use of a porous membrane. The filtration engineer's first consideration is to obtain filtrate of the highest clarity with the lowest build up of solids of a type that reduces flow rates. Rapid plugging involves frequent cleaning of the equipment and considerable downtime. The first step was to study the filtering characteristics of chromic acid solutions and to obtain correlation of laboratory data with field experience.

The liquids usually filtered in the plating industry are considered to be quite simple by comparison with liquids handled by other industries. In the processing of liquid gelatin, syrups, and many chemicals, the intelligent selection and application of filter aids is considered to be the most important factor in the operation. Filter aids are selected for their compatibility with the process liquid, for their effect upon clarity of the filtrate, and for their effect upon capacity and cycle of the equipment. In the case of process water from a paper mill using filter aid as a precoat only and maintaining a constant pressure, the flow rate at the end of a 30-minute cycle was approximately 5.5 gph/sq ft of filtration area. In running a second sample of the same water, but with a continuous feed of filter aid in amounts equivalent to one part of filter aid to one part of suspended solids in the water in addition to the precoat, the flow rate at the end of a 30-minute cycle was 40 gph. Clarity of the filtrate was the same in both tests. The advantage of the continuous power feed in this case was a higher flow rate and a longer cycle resulting in at least a 700 per cent improvement.

Such advantages are invariably recognized in most filtration studies; and, while the continuous or intermittent additions of filter aid during the cycle is common practice in most industries, unfortunately it is seldom advocated for plating solutions. In a similar study with a cyanide zinc plating solution maintaining a constant flow rate but plotting an increase in pressure, three types of filter aids were studied as shown in Figure 1. The interesting factor is the comparatively longer cycle of the test run with the precoat and body addition, which is approximately three times better than the number one filter aid without body addition. In comparing clarification of the filtrate and assuming a rating of 100 as the highest, the number one filter aid with precoat and body addition had a rating of 85, whereas the number one filter aid without body addition had a rating of 80. This is shown in Figure 2. Similar advantages are recognized with other plating solutions and it is predicted that the plating industry will eventually adopt this system where some of the advantages can be realized that have been recognized by other industries.

*Presented at the 42nd Annual AES Convention, Cleveland, Ohio. The discussion following the presentation is not included here but will be found in the "Annual Proceedings of the AES, 1955."

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Similar tests were conducted with chromic acid solutions of various concentrations for the removal of solids resulting from chemical precipitation as well as for the removal of solids extraneously introduced to the plating bath. In every case, it was found that the physical characteristics of the solids were of a shape and nature to act in much the same capacity as a filter aid. The absence of gelatinous films resulted in longer cycles and showed little or no advantage in the use of filter aids other than as a precoat for the filter membrane. The investigation indicated that a flow rate in the order of 25 gph /sq ft of filtration area was realistic and could be sustained over a practical period of operation. As might be expected, values higher than this are possible at the beginning of the cycle; however, the figure of 25 gph was selected as a value that would give relatively longer cycles with a high degree of clarity.

In sizing the production filters, this factor was used; and, as a further safety measure, filter capacity was based on a solution turnover equivalent to one volume of solution per hour. In actual practice the capacity is somewhat less; however, the length of cycle obtained on this basis is well within the normal maintenance in many plating rooms.

CONSTRUCTION OF EQUIPMENT

Most of the common metals or alloys are adversely affected either chemically or electrochemically by the chromic acid electrolyte. A number of applied coatings are attacked by the strong oxidizing solutions and some are either difficult to apply or are too costly for consideration. Wherever possible, only materials that are not affected by these solutions should be used or if some degradation occurs, it should not have an effect upon the operating conditions of the process or upon the deposits. A further consideration is the normal abuse that such equipment receives in the plating room; therefore, the construction should be rugged. A study of all factors indicates that such demands can be met by all steel or iron construction lined or covered with a suitable nonmetallic material. Such prominent lining materials as rubber, Neoprene, and Buna-S are affected by oxidizing solutions and are not satisfactory. Nonplasticized polyvinyl chloride, chlorosulfonated polyethylene and Teflon are satisfactory. Considering the most economic construction and materials, a filter could be constructed as follows:

Tank:	Steel lined with nonplasticized polyvinyl chloride
Valves:	Cast iron diaphragm type lined with chlorosulfonated polyethylene with Teflon diaphragms
Piping:	Steel or iron lined with polyvinyl chloride
Pump:	Cast iron lined with chlorosulfonated polyethylene
Leaves:	Molded chlorosulfonated polyethylene
Bags:	Vinyon N

Flanged connections should be used throughout, and gaskets may be of Teflon or polyvinyl chloride. The area can be based on the capacity described above; and, as the quantity of solids is relatively low, a nominal spacing of one inch between the filter membranes is generally satisfactory.

APPLICATION

The increasing use of precision chromium plating for engineering application has directed considerable attention to eliminating rough deposits, increasing plating bath efficiency and reducing the per cent of defective work produced. A considerable amount of our attention has been focused upon filtration and combined purification-filtration techniques to permit fullest utilization of the advantages of precision plating to the final desired dimensions.

In the early years of application of heavy deposits of chromium for engineering use, the presence of a few nodules, burned edges, milky or striated plate caused little concern. The deposits required grinding to final dimensions and, therefore, these conditions were of little consequence providing sufficient "grinding stock" had been deposited beyond the final finished dimensions to allow these imperfections to be ground away. The modern emphasis on economy and mass production has made this practice of overplating and subsequent grinding unattractive. Frequently as much or more extra tank time was required for plating the "grinding stock" as that which was required for the depositing of the desired thickness of plate. Some applications of heavy deposits are frequently made in locations where subsequent grinding is either difficult or impossible.

In the precision plating of the interior diameter of long cylinders ranging from 0.22 inch to 18 inches in diameter, it was observed that even in spite of the fact that plating was accomplished in a vertical position, nodules were frequently found at locations where solution velocities were low or where escape of the hydrogen generated within the tube was impeded by a fixture, anode, alignment insulator or counter bore. The plated area just adjacent to the point where solution was being drawn into the cylinder was most often rough or noduled. It was observed in a number of instances where the nodule could be detached, it could be picked up with a magnet, thus indicating that it was formed about a particle of steel. In order to observe the degree of contamination resulting from suspended magnetic particles, a 1 x 1 x ¼ inch Alnico magnet was suspended three feet from the bottom and near one end of a 140 x 26¼ x 69 inch chromium plating tank containing 970 gallons of solution. The magnet was located in the opposite end of the tank from the heat exchanger outlet and allowed to remain in place for 300 hours. Figure 4 shows

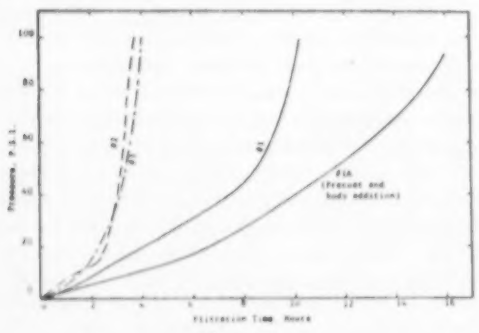

Figure 1
Filtration of zinc cyanide plating solution
Pressure vs time curves

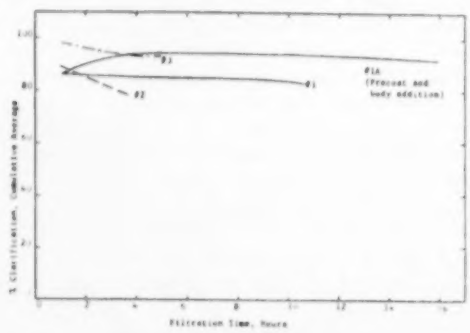

Figure 2
Filtration of zinc cyanide plating solution
Filtrate clarities

the magnet after withdrawal and careful rinsing. In figure 5, the magnetic debris is shown after removal from the magnet. It may readily be seen from the nature of this debris that solution flow, either due to convection, gas caused turbulence or from proximity to the heat exchanger discharge can readily bring these particles within the magnetic field of those parts being plated. There, under conditions of reduced solution flow or due to turbulence in the solution they may attach themselves magnetically to the surface and generate a nodule or gas pit in the plated surface. While all nodules may not necessarily be the result of magnetic particle attachment, it was evident that this might readily be eliminated through filtration or through the use of a magnetic device which would remove suspended magnetic particles as they are discharged from the heat exchanger.

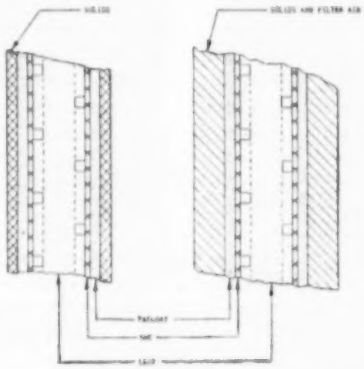

Figure 3
Cross section of filter plates with and without body additions

SOURCES OF CONTAMINATION

Magnetic Particles—The magnetic material shown in figures 4 and 5 was removed from a bath used for plating 0.30 inch internal diameter tubes 2 feet long. These tubes were vapor degreased, mechanically scrubbed in an alkaline cleaner, rinsed, racked with internal cathodes and anodically electro-polished in a solution composed of equal volumes of 66° Bé sulfuric acid and 75 per cent phosphoric acids, rinsed, disassembled from the polishing fixture, mechanically scrubbed, dried and reracked for plating. The tubes are then placed in a 33 oz/gal sulfate-free chromic acid solution and anodically etched for five minutes prior to being placed (without rinsing) in the chromium plating bath. In spite of this rigorous pre-treatment, machining debris finds its way into the plating solution, presumably on the work surface as partially attached fragments inasmuch as the actual machine work is carried out in a separate building.

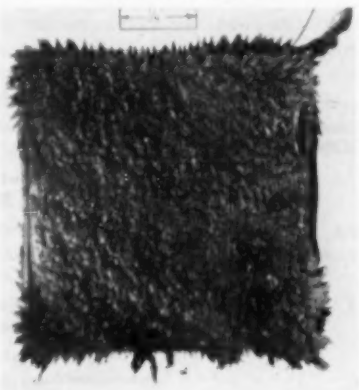

Figure 4
Magnet with adhering magnetic debris after 300 hours immersion in an unfiltered plating solution

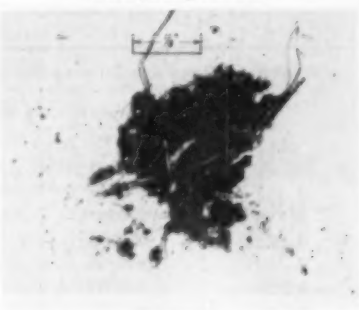

Figure 5
Magnetic debris from unfiltered chromium plating solution

Nonmagnetic debris—A spectographic analysis of suspended nonmagnetic debris filtered from the bath showed the presence of calcium, aluminum, iron, chromium, zinc, copper, magnesium, barium, lead, tin and silicon. Each of these materials can be accounted for as follows:

Calcium and magnesium—From the rinse water drag-in. The chromium solutions are made up and replenished with distilled water.

Aluminum—From the brick lining.

Iron—From the external unpolarized surfaces of the tubes being plated.

Chromium—Associated with the insoluble lead and barium chromate.

Zinc and Copper—From the brazed-on hooks used in the plating fixture.

Barium—From the barium sulfate, or barium chromate used to reduce the sulfate catalyst content of the bath.

Lead and tin—From the lead-tin alloy plated steel internal anodes used in plating the tubes.

Silicon—From the dust settling on the tanks and from the silica-silicate mortar used in setting the brick lining.

Organic contaminants—The unusual oxidizing ability of chromic acid quickly disposes of the lint and most other airborne organic materials which find their way into the solutions. However, small particles of vinyl stop off materials, waxes or decomposition products of the antispray floats sometimes used, will remain in the solution.

Many of the insoluble contaminants discussed above are of sufficient density to settle to the bottom of the tank, but convection due to heating or the gases evolved in plating, or the agitation provided by heat exchangers may suspend many of these materials within the plating zone. While suspended nonmetallic materials may contribute to rough nodular deposits by far the greatest effect is that of increasing the resistance of the solution by providing a tortuous current path. A series of conductivity measurements made before and after filtration of some used chromium plating solutions indicated that conductivity determination could be used as a measure of contamination by suspended insoluble matter. Figure 6 indicates the conductivity improvement obtained in the filtration of several chromium plating solutions and a chromic acid anodizing solution.

The reduction in resistance in the case of chromium plating solutions ranged from 15 per cent in the most contaminated solution to 0.5 per cent in the bath with least contamination. It should be noted that the resistance values shown included the resistance produced by the suspended material plus that resulting from the presence of trivalent chromium ion and other dissolved heavy metals.

The combined benefits of reduced power consumption and the virtual elimination of rough nodular deposits through filtration can result in considerable saving to even the smallest job plater.

Perhaps the most oustanding future use of filtration of chromic acid solutions will be in connection with chemical oxidation of trivalent chromium. Preoxidation of trivalent chromium with or without cation exchange purification will provide attractive savings. Since its commercial inception in 1950[1], cation exchange purification has been installed in many of the larger chromium plating and anodizing plants. In the cation exchange process, cationic contaminants such as trivalent chromium, iron, copper and aluminum are removed by passing the diluted solution through a column containing the acid form of a divinylbenzene sulfonate cation exchange resin. Metallic ions are removed from the solution in the process and are replaced by hydrogen. Unfortunately, the resin has low capacity for trivalent chromium ion and after

the passage of only a few gallons of trivalent chromium contaminated solution, the ion can be detected in the effluent. This early bed leakage results in an overall removal of only approximately 60 per cent of the trivalent chromium and makes frequent regeneration of the resin necessary. Capacity of the resin to remove trivalent chromium iron, aluminum and copper is approximately 0.5 lb/cu ft of resin when the influent chromic acid concentration is 100 g/l. Trivalent chromium in most instances represents the largest bulk of the solution contamination and is unfortunately the ion for which the resin has the poorest capacity. The volume of exchange resin must therefore be scaled considerably larger than would be necessary if trivalent chromium ion was not present. Obviously, if the trivalent chromium could be economically reoxidized to useful hexavalent chromium, the capacity of a given volume of resin for other cations would be increased several fold. In order to accomplish this, the preoxidation process has to produce an easily removable or innocuous reaction product in order to make the process useable. A survey of the available oxidizing agents showed that only a few had the ability to oxidize trivalent chromium to hexavalent chromium ion in acid solution. Of the several chemicals available, potassium permanganate offers an interesting possibility. The reaction between the trivalent chromium and the permanganate ion can be represented as follows:

POTASSIUM PERMANGANATE OXIDATION OF TRIVALENT CHROMIUM IN CHROMIUM PLATING SOLUTIONS

$$2\ KMnO_4 + Cr^{+++} + H_2CrO_4 \rightarrow 2\ MnO_2 + K_2Cr_2O_7 + H_2O$$

Oxidation of one pound of trivalent ion with 3.04 pounds of potassium permanganate produces the following reaction products:

Hexavalent chromium ion equivalent to 1.9 lbs. chromic acid	
Potassium ion	0.376
Manganese dioxide	1.6
Water	1.064

In the reaction, manganese dioxide is precipitated and potassium ion remains in the solutions. For every ounce of trivalent chromium to be oxidized, 3.04 ounces of potassium permanganate is required and 1.61 ounces of manganese dioxide will be precipitated. Potassium ion remaining in the solution after the reaction will be 0.376 ounces.

The cost of producing chromic acid by this process would at first appear to be high in view of the fact that roughly three pounds of potassium permanganate are required for each pound of trivalent chromium oxidized. Using a cost figure of $.24 per pound for permanganate, the chromic acid produced would cost $.379 per pound or approximately 25 per cent higher than the current market price of the chemical. This small differential is more than compensated for by the savings realized from increased capacity of the cation exchanger and improved solution conductivity.

Tests were made to determine whether the freshly precipitated manganese dioxide was appreciably soluble in the standard 33 ounce (100–1 sulfate ratio) chromium plating bath. The solubility was found to be in the order of less than 10 mg/100 ml.

In one test run, 1000 gallons of 33 ounce (100–1 sulfate ratio) chromium plating solution containing 0.86 oz/gal trivalent chromium was treated with 450 pounds of potassium permanganate (nearly 3 times that required). The dry potassium permanganate was added directly to the solution in the plating tank. After a period of air agitation to affect dissolution and reaction, the solution was pumped from the tank to a dilution tank where the concentration was reduced to approximately 100 g/l with deionized water. The manganese dioxide was removed by filtration through a diatomaceous silica-precoated filter. The clear dilute solution was found to be trivalent chromium free and had the characteristic cherry-red color of such solutions. The solution was passed through a 68 cubic foot column of cation exchange resin previously placed on the hydrogen cycle by treatment with 2400 gallons of 10 per cent sulfuric acid. Samples of the effluent chromium solution were taken at 300 gallon intervals and subjected to spectographic analysis. The effluent sample taken after 1390 gallons had been treated, showed less than 0.01 per cent potassium and indicated initial breakthrough of that ion. Neglecting the presence of other cations which would reduce the total potassium capacity of the resin, this would indicate

Resistance of Chromium Plating and Anodizing Solutions Before and After Filtration

Tank Designation	Composition (oz/gal)			Resistance (Ohms) Prior To Filtration	Resistance (Ohms) After Filtration
	CrO_3	SO_4	Cr^{+++}		
6	31.4	0.314	1.680	2.878	2.449
4	33.4	0.354	1.703	2.437	2.089
24	31.5	0.284	0.097	2.077	2.053
5	32.9	0.333	1.375	2.321	2.167
9	34.1	0.326	1.368	2.287	2.204
7	34.0	0.337	1.710	2.236	2.161
10	32.0	0.289	1.477	2.227	2.160
H	30.8	0.334	0.514	2.077	2.022
8	30.3	0.280	1.448	2.319	2.272
11	35.8	—	1.790	2.249	2.205
FS	31.2	0.302	trace	1.748	1.707
3	34.3	0.359	0.548	2.157	2.117
27	31.9	0.330	1.900	2.234	2.201
FL	33.1	0.335	0.0834	2.003	1.973
22	25.3	0.251	0.0702	2.517	2.494
25	34.1	0.340	0.0918	2.019	2.006
25E	29.5	0.334	0.0867	2.155	2.147
Anodize	5.57	—	—	1.999	1.734

Figure 6 Table of conductivities

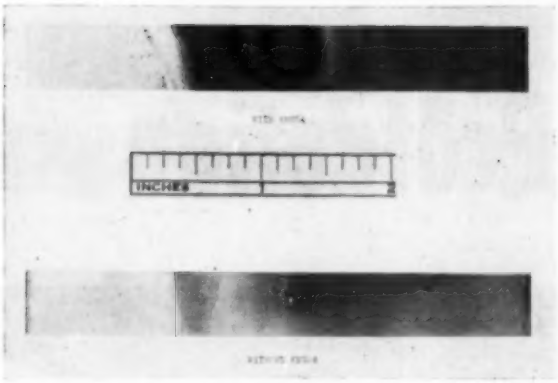

Figure 7
Hull cell panels showing the effect of potassium permanganate on the performance of chromium plating solutions

a capacity of approximately 1.25 pounds of potassium per cubic foot of resin. Only a trace of precipitate was observed when 100 ml of solution was made alkaline with ammonia, thus indicating substantially complete removal of heavy metals.

It was at first believed that if an excess of permanganate were added to a bath, this might result in difficulty in subsequent plating operations or in the deposition of manganese dioxide in the cation exchange column. Hull cell tests were made on used plating solution to which an excess of permanganate was added. Figure 7 shows a comparison of panels prepared before and after the addition. It will be noted that a deposit of manganese dioxide is obtained between 80 and 140 amp/sq ft. At current densities upwards of 140 amp/sq ft normal deposits are obtained. When all suspended manganese dioxide was removed, the band of deposited manganese dioxide disappeared.

Unreacted potassium permanganate entering the cation exchange column, is converted to unstable permanganic acid which decomposes to form manganese dioxide. The small amount of manganese dioxide thus produced was easily removed during the back washing process. As stated before, each cubic foot of resin will retain approximately 1.25 lb of potassium. It is well known that the potassium form of the resin will salt split and release potassium in the solution retaining the heavy metal ion. Thus, some potassium may enter the solution if the entire capacity of the resin should be consumed by potassium. This results in the complete exchange capacity of the resin being available for removal of heavy metal contamination. The frequency of regeneration of the resin is therefore drastically reduced, thus providing a very substantial saving in both chemicals and man power. The high tolerance for potassium or sodium ion in chromium plating solutions[2] makes it possible for the small job plater to oxidize the trivalent chromium in his plating bath with potassium permanganate, filter and return the solution to the plating tank without further treatment.

Where cation exchange equipment is available, the treatment will remove all heavy metal contamination along with all or part of the potassium ion.

HOW FILTRATION CAN AID THE CHROMIUM PLATER

For the chromium plater, filtration can provide heretofore unseen economies. Reduced tendency toward formation of nodular deposits after filtration will allow deposition of greater thicknesses of useful chromium with reduced tank time. Lower generator loads will be encountered due to the shortened current path resulting from suspended particle removal.

Availability of a filter will allow the small job shop plater to remove the trivalent chromium which, through its solution resistance, overloads his generator or rectifier. Simple addition of 3.04 ounces of potassium permanganate for each ounce of trivalent chromium as metal in the solution, followed by filtration will increase the throwing power of the solution, reduce the burden on power sources, and allow continued use of solutions which would ordinarily need to be discarded.

For the plating department already equipped with cation exchange purification equipment, preoxidation of trivalent chromium with permanganate followed by filtration and cation exchange will provide savings by materially reducing the frequency of regeneration of the resin. The extreme purity of the treated solution will also provide all the beneficial effects noted above.

A plating plant operator contemplating installation of cation exchange equipment can install a smaller cation exchange column with the same capacity for solution purification as a unit several times its size if oxidation of trivalent chromium followed by filtration is used.

Chromic acid anodizing baths can be treated in the same manner as indicated for chromium plating baths with the same benefits and considerable saving.

REFERENCES

[1]L. O. Gilbert, F. Kahler and W. S. Morrison, "Use of Ion Exchange Resins in Purification of Chromic Acid Solutions," Proc. Amer. Electroplaters' Soc., 1952, **39**, 31–54.

[2]H. W. Deltner, "The Tetrochromate Chromium Plating Bath," Metalloberfläche, Vol. 5 No. 10, p. B151.

R. F. LEDFORD

Ledford

Ledford became interested in metal finishing while attending Western Michigan College. Beginning with his freshman year until shortly after graduation, he worked for the Kalamazoo Plating Co. attaining the position of production manager of the Kalamazoo Plant and general manager of the Battle Creek Plant. In 1943 joined Hanson-Van Winkle-Munning Co. In 1951 joined Sunbeam Corp. as superintendent of finishing and in 1952 joined the Industrial Filter and Pump Mfg. Co. as sales manager. Ledford is a member of the Electrochemical Society, the American Ordnance Association, Chairman of Sub-Committee III of Committee B-8 ASTM, and a present member and past president of the Chicago Branch, AES.

LLOYD O. GILBERT

Gilbert

Gilbert attended St. Ambrose College and Augustana College, Rock Island, Ill. He is chief chemist, metal finishes lab., Rock Island Arsenal, Rock Island, Ill. Gilbert is a member of the Electrochemical Society, Government liaison member, ASTM B-8, chairman Sub-Committee V, Section D American Ordnance Association and is a member of the Chicago Branch, AES.

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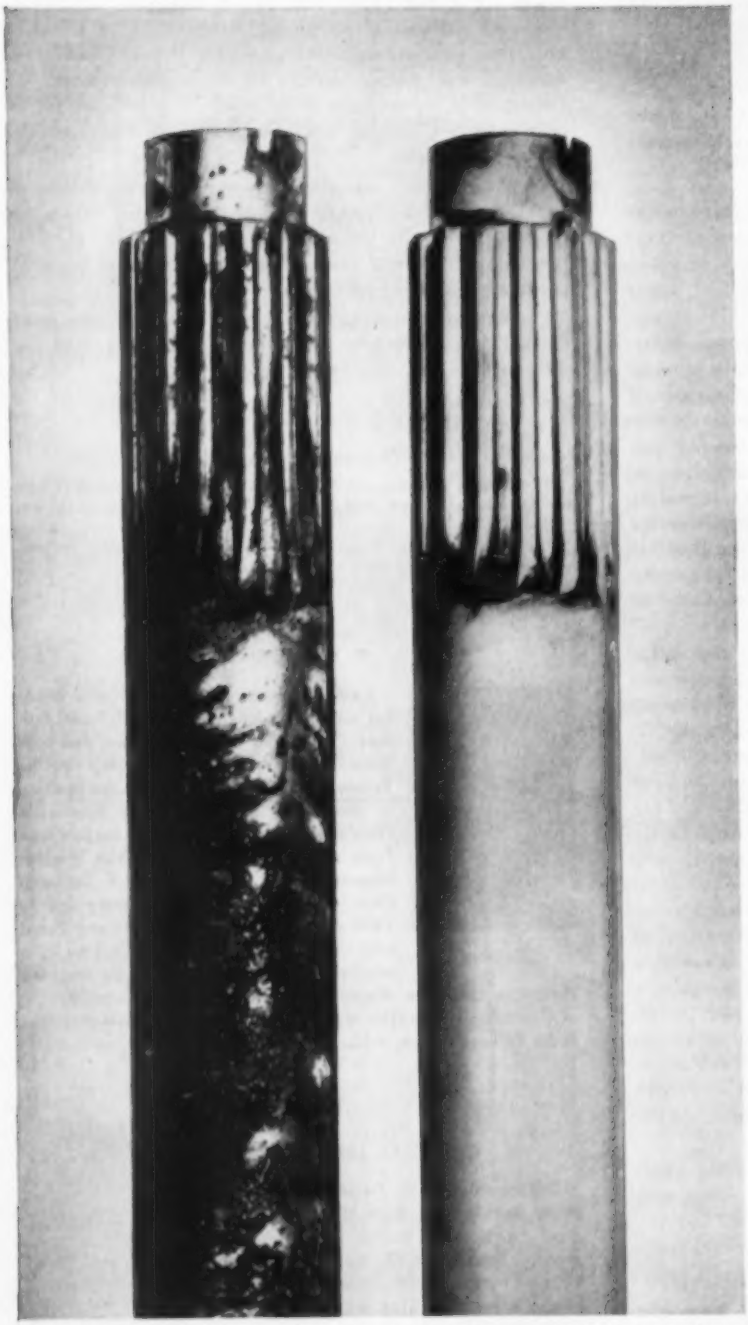
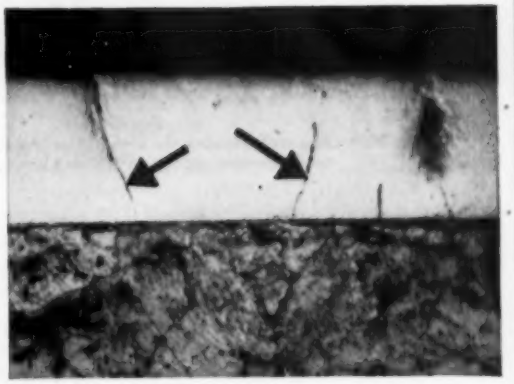
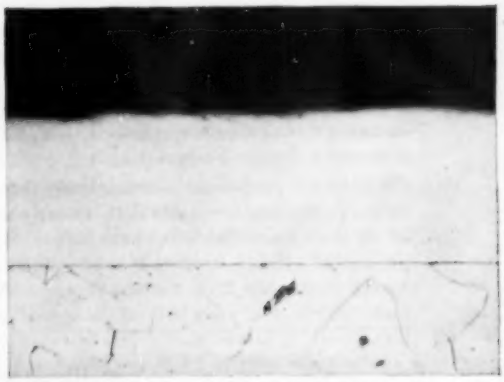


Surface of steel shaft at left, with 0.0005 inch of ordinary chromium, showed rust over entire surface after 100-hour salt spray test.

Shaft at right, with 0.0005 inch of Crack-Free Chromium, was virtually unaffected in the same test.



Photomicrograph showing cross section of etched ordinary chromium plate .00125" thick. Some cracks extend through the deposit to the steel.



Photomicrograph of a cross section of etched Crack-Free Chromium also .00125" thick. Note the absence of cracks.

Parts showing the matte finish of the Crack-Free Chromium deposit and the two tone effect achieved by buffing portions of the work.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 942.

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Unichrome Crack-Free Chromium Plating gives ductile deposits which are relatively free from internal stress. Thus, unlike ordinary chromium deposits, they do not crack as thickness builds up. They offer you crack-free finishes that assure longer service life, greater reliability and protection

Superior Corrosion Resistance

In hard plate thicknesses, Crack-Free Chromium gives striking results. Even when plated directly on the base metal, it provides a dependable barrier to corrosion. Ordinary chromium of the same thickness is full of cracks—cracks so small they are usually not visible to the unaided eye. Many of these cracks extend all the way down to the base metal, making it impossible for ordinary chromium alone to deliver complete protection against corrosion.

In 100% relative humidity tests conducted at 110°F, parts plated with .0003" of Crack-Free Chromium were rust-free after a full year of exposure. Parts plated with ordinary chromium were completely covered with rust after just a few days. In laboratory and outdoor exposure tests, Crack-Free Chromium has proved its superiority time and time again.

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A matte, gray plate, Crack-Free Chromium buffs up readily, like dull nickel, to a high lustre. You can get smart two-tone effects by coloring up only portions of the work.

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- **Easier, faster grinding**
- **Resistance to thermal shock — better protection at elevated temperature**
- **Impact resistance**
- **More ductile deposit**
- **Easy buffing — as easily as dull nickel**

Conserves Nickel

Since it develops a dense, continuous deposit, Crack-Free Chromium doesn't depend on scarce nickel to stop corrosive agents from reaching the base metal. It protects all by itself . . . can be plated directly on steel and zinc die castings for many applications.

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AES News

Baltimore-Washington Convention

NOSTALGIA

WITH summer and vacations now drawing to a close, let's pause a moment and reminisce. Ah, what nostalgic bliss! But only the 350 fortunates—less some, God rest them—who attended the Washington convention 25 years ago can appreciate memories invoked by the above reproductions taken from the Monthly Review.

That was way back when Horace Smith was succeeded by George Gehling as President of the Supreme Society which operated on a total budget of $4152.26 . . . including $5.25 for "Sundries." The circulation of the Monthly Review totalled 1575 copies, and the June issue had 56 pages . . . the Editor's office expenses for the year were $45.35. Did someone just say this was when a nickel would still buy a good cigar? But who had nickels in 1930!

As anyone can plainly see, the 1930 Convention got some jim-dandy publicity, written in lingo readily understood by the more "hep" platers of the roaring 'twenties. And the silhouettes of ultra-modern travelling conveyances make it plain that Paul Revere and his horse had really, but definitely, been outmoded. That there was luxury, no doubt of it! But even then, it seems, platers demanded the best.

Dr. Blum had the job of corraling speakers for the program . . . Fred Pierdon was in charge of hotel arrangements and his wife handled the ladies' activities. The Detroit branch, from proceeds of the Convention the year before, donated $150 to assist in defraying expenses. And the sights of the Nation's Capitol were held out as an inviting decoy. With the prospect of a partial rebate of the fare back home, how could one resist?

Well, times have changed . . . or have they? The 1956 Convention beckons you to Washington again. The Statler Hotel is prepared to offer its plushest service during your stay from June 18 to 21. You can still come by "land, or sea, or air," and by pogo stick will save you money if you can spare the time. (This will have to be officially cleared by the Committee, but a fare rebate for Pogo Stickers is in prospect).

Dr. Abner Brenner, successor to Dr. Blum, will worry through the problems of recruiting speakers . . . and Abner hasn't ever yet done a poor job. Following in his father's footsteps, Art Pierdon has long been hard at work as General Chairman, and Mrs. Pierdon is preparing to keep the ladies happy. To date the Detroit branch has vouchsafed none of its wealth, but it can't hurt to hope! And Washington has many new sights . . . as if all us taxpayers didn't know!

A. E. S. ANNUAL CONVENTION

Come to Washington, D. C., Educational Bee and Make a Little Whoopee—But Do Not Forget Your Certificate from Railroad, It Means One-half Fare One Way. Heh, Heh

The Annual Convention of the American Electroplaters' Society is to be held this year at the Mayflower Hotel in Washington, D. C., on June 30, July 1, 2 and 3. Splendid accommodations can be obtained at the hotels at very reasonable rates. As the day following the Convention is a holiday (July 4), it will be convenient to spend the rest of the week in Washington seeing the many sights. This would make a wonderful vacation for the whole family.

BY LAND . . . . .

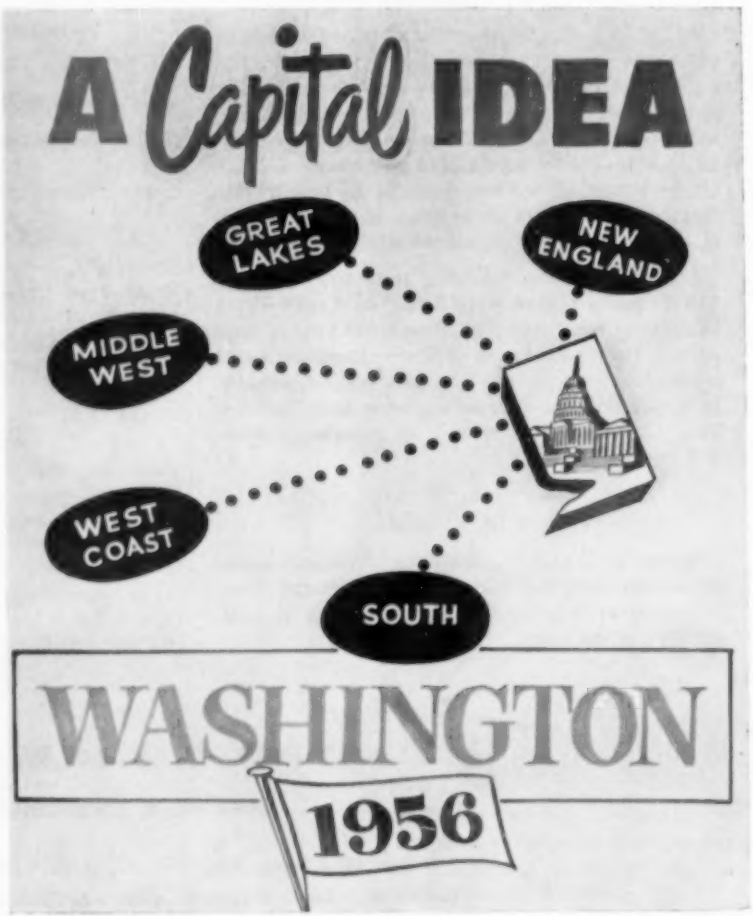
OR SEA . . . . .

OR AIR . . . . .

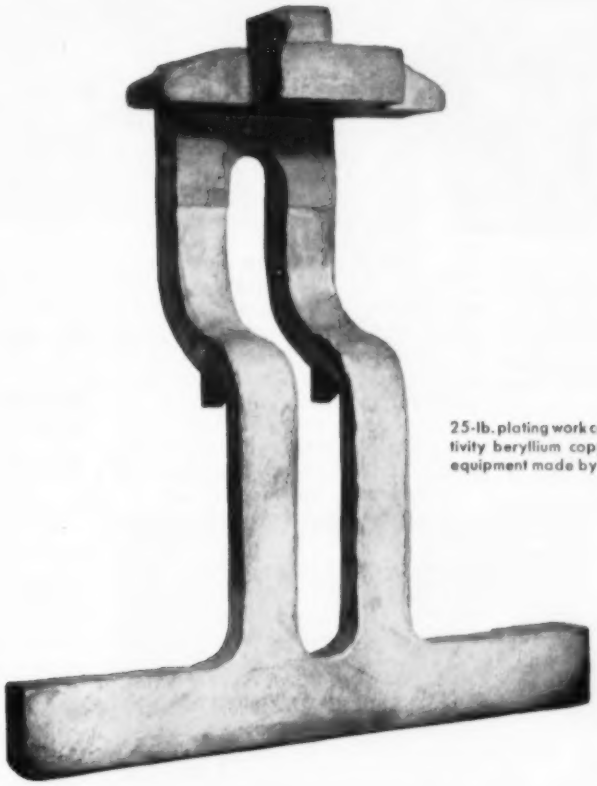
We only need 125 certificates when we purchase our ticket to get one-half fare back home. Get one.

Committee.

So, let's all plan now to get to Washington in 1956 . . . at least to be assured of nostalgia in 1970 or thereabouts! So on to Washington . . . It's a Capital Idea!



WHEN PARTS ARE CAST FOR A TOUGH ROLE



25-lb. plating work carrier cast in high-conductivity beryllium copper and used in plating equipment made by The Udylite Corporation.

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The increased amperage called for in modern plating equipment demands higher conductivity in this casting—a contact which rides on a copper bus bar and transmits current from the bar to the plating tanks. Various materials used in the past, although they had the required wear resistance, lacked the conductivity for this application. To get around the problem, engineers considered brazing a strip of high-conductivity "Berylco" beryllium copper to the part.

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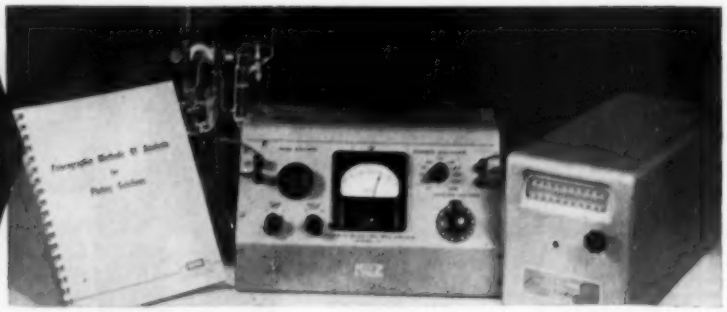

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We've gone one step further. Our new 65-page manual (just off the press) tells the plater—step by step—how to use the C-1 Electro-Polarizer to find the exact content of his plating solutions—in *Minutes!* It also has alignment charts for 19 common solutions which reduce computations to slide-rule simplicity.

The Patent Button Company

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3045	3.0 to 4.5	" "
3954	3.9 to 5.4	" "
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96111	9.6 to 11.1	Brass
115140	11.5 to 14.0	Copper (cyanide)

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AES News

More Convention Echoes

By Frances M. Hoffman

Happy Memories, Friends!

"All good things must have an ending, but this particular ending came much too soon"—so said the Women's Auxiliary of the Cleveland Branch of the American Electroplaters' Society. Although we all realize that you came from beautiful cities near and far, we still had a little selfish "spark" and wanted to keep you a little longer as our guests in Cleveland.

The 459 ladies who came to live with us, are fully aware of what we did from June 19th to June 23rd. However, many ladies were not able to live with us in Cleveland, so, we will give them a brief summary of our activities.

The "Get-To-Gether" party on Sunday night was great fun. Norman Knuth and his Starlighters furnished dreamy music in Hotel Statler's beautiful ballroom, while friends gathered from everywhere, for an evening of getting acquainted with new friends as well as chatting with already established friends.

Delicious refreshments were served while the Women's Auxiliary graciously made all comers feel "at home," because they wanted to keep Cleveland's theme in the foreground at all times,—"Living in Cleveland." It was a perfect evening to "set the stage" for our Convention Activities.

The opening session on Monday morning was the official opening for both men and women. E. M. Combs, of Diamond Alkali, General Chairman, graciously welcomed our guests, while Frances M. Hoffman, Ladies' Activities Chairman, assured the Ladies that they were most welcome and important in the Convention program. Manson Glover, President of Metal Finishing Suppliers' Association, Inc., gave an enlightening address on "The Role of the MFSA in the AES." Then Dr. Ralph Schaefer, President, very ably conducted the business meeting.

At noon, the men went to their respective sessions, while the ladies gathered in the beautiful and unique Alpine Village for their tasty luncheon. World famous Herman Pirchner himself, arranged for a Broadway Review which everyone enjoyed. Last minute complications prevented Mr. Pirchner from carrying through the planned Television Show. However, his arrangement of the "Audience Participation" was a wonderful substitute. Although some of the ladies had to work hard to carry away winning prizes, beautiful California Bags were selected by the Women's Auxiliary for all. Then to the ladies great amazement, a perfect gift was waiting for them at the door. This was the exquisite jewelry by Coro, which was so graciously selected and donated by the Harshaw Chemical Company.

Monday night, the Metal Finishing Suppliers' Association, Inc., sponsored the Fellowship Open House. The supper was delicious and dancing to the lovely music was enjoyable and delightful.

Tuesday morning, the ladies gathered at Halle's Tea Room for brunch. We participated in a radio show with Louise Winslow. Star guests and door prizes were featured.

Tuesday noon, the ladies lived with us in beautiful Higbee Auditorium. This was, of course, the "Aunt Ella" party sponsored by Oakite Products, Inc. A delicious luncheon was served to 397 ladies. Dave Clarin was the gracious host. Again, he brought back lovely gifts from his trip and presented them to the two lucky ladies. Organ music with the beautiful decorations representing Cleveland's famous Severance Hall, made an ideal setting for this traditional and always lovely activity. Thank you Mr. Carter, for the interesting and thoughtful message. The Ladies Auxiliary arranged for door prizes given to some of our lucky ladies, while Rain Bonnets found their way into each lady's purse.

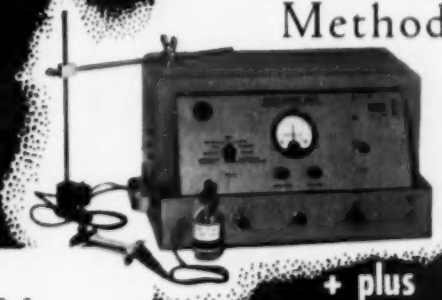
Then we were favored with Mr. Clarin's Magic. In his many travels, he must have absorbed the "Out of the World" secrets. Mr. Clarin's scissors can cut Mr. Bruenning's necktie and then, behold Mr. Clarin's magic words, can put the necktie together again. Delightful! Thank you Mr. Clarin and Oakite Products for this very lovely activity.

The ladies spent Tuesday evening admiring the Exposition. They all agreed it was a well organized work of art.

Wednesday, we lived in suburban Cleveland. The busses took us to Westgate Shopping Center and when the ladies mounted the busses again for Lake Shore Hotel, packages of all kinds were tucked in purses or shopping bags. The ladies were given colorful corsages and they made a very lovely picture entering de-

Check plating thickness
WITH THE
KOCOUR ELECTRONIC THICKNESS TESTER

*Anodic Solution Method

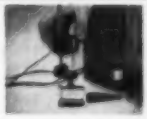


6 Simple steps . . . to quick, accurate results

1. MOUNT THE CELL . . . on the spot to be tested and clip lead wire to specimen.

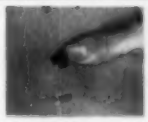
2. ADD TEST SOLUTION . . . which corresponds to the type of plating and base metal tested.

3. PLACE STIRRER IN POSITION.



4. SET SELECTOR SWITCH to the type of plating to be tested as indicated on panel.

5. PRESS THE TEST BUTTON to start the test . . . and upon completion the unit shuts off automatically.



6. TAKE THE READING directly from the counter on panel i.e. 0.00041"

TOTAL TIME . . . less than 2 minutes

+ plus these features

- DETERMINE THICKNESS OF decorative chromium, heavy chromium, silver, copper, tin, brass, cadmium, nickel, zinc, lead, lead-tin alloy, tin zinc alloy on various base metals and materials.
- WIDE THICKNESS RANGE
- DIRECT READINGS
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- TESTS ARE RAPID
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THE FINISHING TOUCH

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by D. J. Swaninger
Sales Manager—Stevens Compositions

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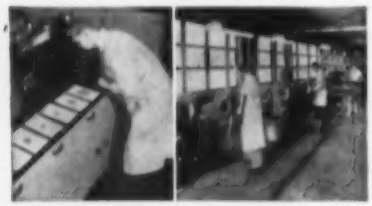
An L. V.* Report works like this: You send us several samples of parts for experimental polishing and buffing. You tell us how you are operating at present, give us your problem and what you desire to accomplish.

Shortly and without obligation you will have your Stevens L. V.* Report and recommendations. For polishing—type of wheel or belt, diameter, width, r.p.m., abrasive, composition. For buffing



—description of buff and diameter and r.p.m. and composition used. For coloring—description of buff, number of sections and compositions used. Similar information is furnished for brushing or deburring operations. The L. V.* Report represents the sequence of operations with the type belts, wheels, buffs and Stevens buffing compositions recommended and verified for your job. When your finishing operation may be improved with automatic equipment such recommendations are also included in the report.

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STEVENS
INCORPORATED
YOUR METAL FINISHING SUPERMARKET
DETROIT 16, MICHIGAN

AES News

lightful Seaglade Room at the Lake Shore Hotel, for a delicious luncheon. This was our Educational Session and was sponsored by the Udylite Corporation. R. C. Tress, in person, graciously came to add the necessary "touch." The Gay Ninety's, in costume, entertained us in a merry fashion. Prizes went to several lucky ladies. Did you know that—we had a honeymooner—and visitors from France and from Australia? And, a lady who was at the first convention when only seventeen ladies were present? Mr. Tress was responsible for the handy and attractive measuring tape. Not to measure distance to Cleveland, but to think of the lovely Udylite luncheon during the year as you make your new wardrobe for the Convention next year.

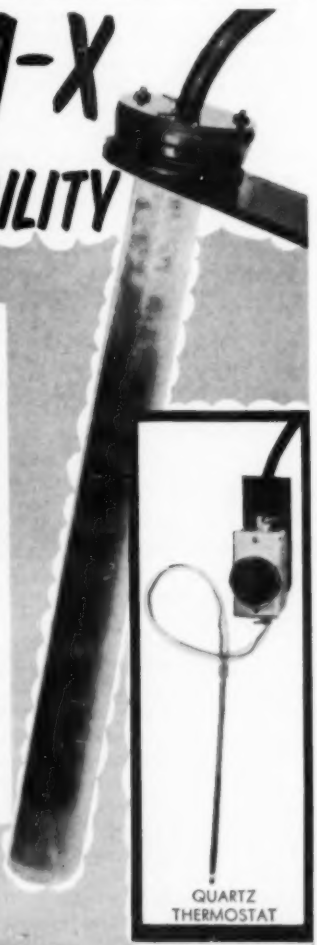
Then came the Educational part of the program since we "Yearn to learn." We were delighted with Dr. R. B. Saltonstall's address on "Costume Jewelry." His talk was most interesting as well as informative. Did you know where we got most of our stones for costume jewelry? Do you know the plating time of costume jewelry? How the "shapes" of jewelry are acquired? If not, perhaps we can "coax" Dr. Saltonstall to address the ladies again at some future time—soon. At least, I'm sure the ladies are hoping! Thank you Dr. Saltonstall for a fine address.

Wednesday evening was an evening "chuck" full of gaieties. The floor show was exciting, the orchestra and dancing very romantic and all in all, everyone reported a jolly time.

Thursday morning was the traditional Plato Party, with Mrs. Joan Wiarda serving as guest hostess. There were "Oh's" and "Ah's" as the ladies entered the room.

new THERM-X

QUARTZ IMMERSION HEATER
FOR RUGGED DEPENDABILITY



Here is an immersion heater with all of the plus features. Constructed with a pure fused quartz shell, it is chemically inert from practically all solvents.

The "THERM-X" heater is available in lengths from 10" to 72", from 100 to 10,000 watts and 115, 230 and 440 volts. Heater supports and protection tubes are also available. Put these newly developed heaters to work for you and be SURE you are using the finest.

"SNAP-ACTION" QUARTZ THERMOSTAT
For Control of Corrosive Liquids and Gases

An outstanding development in heat control. Immune to chemical attack but extremely sensitive to temperature. Finger tip control by adjusting simple dial.

RATING: 22 Amperes at 120-240 volts.
Capillary tubing length 36"

Send today for descriptive literature.

Manufacturers of a complete line of immersion heaters.

N.J. THERMEX COMPANY, INC.
535 BERGEN STREET, HARRISON, N. J.

AES News

The shining Plato prizes glittered on the table and thirty-three lucky ladies carried away one of these treasures with faces that radiated much joy. Thank you, Joan. You were very helpful and the prizes were lovely.

Then, all the ladies were delighted with surprises that awaited them. The colorful hand made earrings, selected by the Women's Auxiliary; the very lovely and traditional playing cards from W. Green Electric; the beautiful corsages from Rapid Electric presented by Mr. William Bryan, in person. Then the lasting desk pen, chosen by the Women's Auxiliary and neatly engraved to give it a memorable status in the Ladies homes. Thank you, W. Green Electric and Rapid Electric for your generosity and for the joy which you gave to all of us.

Following the Plato Party, we enjoyed a super-luncheon in the Crystal Ball Room of the Hotel Cleveland. Everyone was delighted with the many treasures and waiting to learn what will happen next. After a very luscious luncheon, Dorothy Fuldheim, World Famous News Analyst, addressed the group on "East is West" in which she gave a vivid picture of her trip to Formosa. She was charming.

Thursday evening brought the traditional Banquet. The dinner was superb! The gifts appropriate, the all-girls' orchestra delightful. The evening was one which touched the last "cord" and the jolly, colorful, musical and educational convention was over.

And now, because the Convention was in my own city, please allow me to add a little personal ending.

The Women's Auxiliary, which made up the Women's Committee, are anxious for you to know that you were truly, very friendly, gracious and co-operative visitors. Cleveland was more fun during the Convention week, because you lived with us. Not only did we try to be gracious to you, but we actually had a good time executing all the activities.

Repeatedly you have heard me say to our visitors, "You are wonderful." I meant exactly that, whole heartedly. Today, I also want to say to the Ladies Auxiliary, "You were wonderful" and a big "Thank You" to all of you.

To the friends we made—please keep us on your list and we shall keep you on ours. In the Conventions to come, won't you come and say "Hello" to us? That will be our lasting reward.

And now, what about next year? We are looking forward to the Convention in Washington. Mrs. Mary Pierdon has already graciously extended an invitation to all of us. We are confident it will be the best convention in 1956.

Gratefully yours,
FRANCES M. HOFFMAN

SPEED UP PRODUCTION with DOUBLE-ACTION DRYING

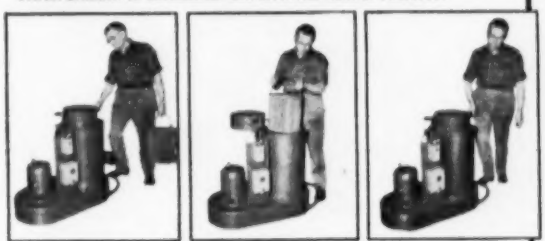
Air-dry as you spin-dry with the new, improved New Holland Model 20 KREIDER CENTRIFUGAL DRYER

• Now you can *spin-dry* small parts in continuous *fresh air* in as little as 15 seconds.

Double-action drying with peak-efficiency evaporation gives smooth moisture-free surfaces . . . reduces your finishing problems by eliminating the scarring frequently responsible for costly "rejects."

Your operators will be able to boost production, cut costs way down when you install New Holland's easy-to-run Model 20 Kreider Centrifugal Dryer.

SAFER because of Mechanical and Electrical Control Features!



To unlock cover and remove basket, operator must depress foot brake, stop spinner.

Machine cannot start with open cover. Ample clearance allowed for quick loading.

To start spinner, operator must first close cover completely.

SPECIFICATIONS:
1 h. p. motor—220, 440, 550 volts—2- or 3-phase—spins 75-lb. loads at 825 r.p.m. . . . Quiet V-belt drive . . . 30-blade suction turbine draws air through spinner . . . . Arc-welded steel-plate construction . . . Heavy-gauge woven steel mesh basket . . . Weight: 490 lbs. . . . Floor space: Just under 5 sq. ft. . . . Meets N.E.C. specs. **Optional:** J.I.C. Control: Mounted on right, left side or wall. 160° supplementary heat: 2350-watt Chromalox, or steam.

Send for illustrated 4-page folder. Address Dept. PM-955 New Holland Machine Company, New Holland, Pa.

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NEW HOLLAND, PA.

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AES News

Practical Course in Newark

A course in basic practical electroplating will be sponsored by the Newark Branch of the American Electroplaters' Society during the Fall of 1955 in response to an urgent appeal for electroplating instruction by both members and nonmembers of the Society. The course will consist of eleven weekly sessions meeting for two hours each on successive Tuesday evenings beginning on September 27 and ending on December 6, 1955. Five sessions will be devoted to preparation of the basis metal for plating, four sessions will cover various commonly used plating processes, and two sessions will deal with maintenance and control of plating solutions. The instructors, selected on the basis of their specialization in particular phases of electroplating, will be for the most part members of the Newark Branch.

A novel feature of the course is that the meetings will be held at various industrial plants and laboratories in the Newark area so as to combine plant tours with the lectures. The schedule for the 1955 course is shown in the Table below. Approximately 40 students have been accepted for the course and certificates will be awarded at the Newark Branch meeting on December 16, 1955 to those students who have successfully completed the course.

The Electroplating course will be under the chairmanship of **Dr. Dodd S. Carr**, Assistant Director of Electrochemical Research, Bart Laboratories Co., Inc., Belleville 9, N. J.

Schedule For Electroplating Course

Meeting No.	Date	Meeting Place	Subject	Instructor
1	9-27-55	Hy-Grade Plating Co. Newark, N. J.	Introduction to Electroplating Racking of Plating Work	D. S. Carr E. Wagner
2	10- 4-55	Oakite Products, Inc. (Labs) New York, N. Y.	Metal Cleaning and Pickling	G. A. Lux
3	10-11-55	Hanson-Van Winkle-Munning Co. Matawan, N. J.	Polishing and Buffing	J. Badaluco
4	10-18-55	Metal Finish, Inc. Newark, N. J.	Barrel Finishing	P. E. Kirchartz
5	10-25-55	Oakite Products, Inc. New York, N. Y.	Electrocleaning and Phosphate Coatings	G. A. Lux
6	11- 1-55	Royal Plating & Polishing Co. Newark, N. J.	Copper and Dull Nickel Plating	L. Donroe
7	11- 8-55	Pyrene Metal Finishers, Inc. Newark, N. J.	Bright Nickel and Chromium Plating	L. Donroe
8	11-15-55	Hanson-Van Winkle-Munning Co. Matawan, N. J.	Analysis and Control of Plating Solutions	D. G. Foulke
9	11-22-55	Sel-Rex Precious Metals, Inc. Belleville, N. J.	Precious Metal Plating Solution Analysis	E. C. Rinker
10	11-29-55	Bart-Messing Corporation Belleville, N. J.	Purification and Filtration of Plating Solutions	D. S. Carr M. W. Mitchell
11	12- 6-55	Kosmos Electrofinishing Research, Inc. Belleville, N. J.	Cadmium and Zinc Plating	J. Kosmos

Extra-at no extra cost
We offer product-quality above the industry standard, the interested attention of owner-managers and heads-up local service by as fine a line-up of distributors any manufacturer can have.
If these "extras" appeal to you, we'd like to have a modest order when you're in the market. We are sure you'll appreciate the quality of BFC Chromic Acid and the nice, friendly way we do business.
CAUTION! DANGEROUS!
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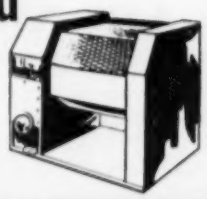
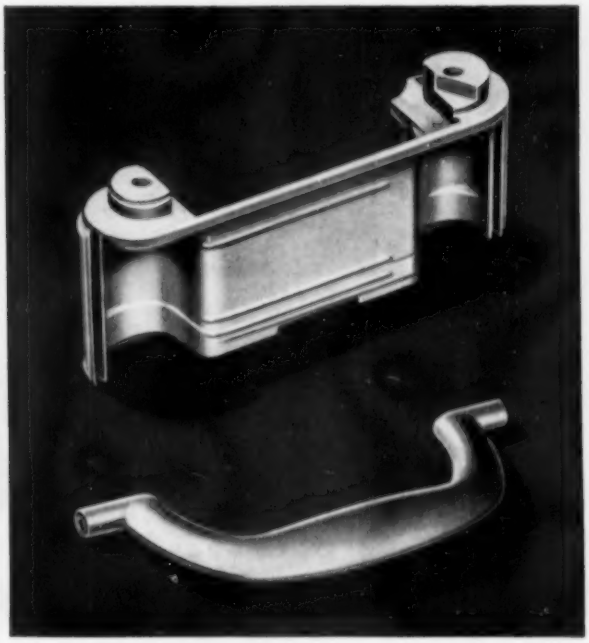
268 Doremus Ave., Newark 5. N. J.
122 East 7th St., Los Angeles 14, Calif.
BFC

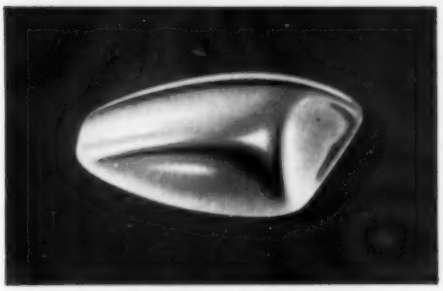
HANDSOME, NEW Sustaining Membership Plaque was unveiled in June and sent to more than 300 firms currently supporting the AES research program. Each new Sustaining Member will receive this innovated walnut-laminated plaque with individual firm name properly inscribed. Upon renewal of membership, a smaller date-plaque will be issued for hanging underneath the larger one. (Pretty hands belong to Miss Marie Citarella, bookkeeper and secretary to the Executive Secretary)

PRODUCT OF **3M** RESEARCH

New HONITE "Micro Cut" Compound gives super smooth finishes on zinc and aluminum die castings!







Use HONITE "Micro Cut" Compound for Mirror Finish on Stainless Steel

On stainless, new "Micro Cut" Compound mirror finishes without darkening, preserving the metal's bright natural color. Impingement control prevents scratches and nicks—corner break is generated with NO dimension change.

Yes, now you can put a super smooth finish on zinc or aluminum die castings. New HONITE Brand "Micro Cut" Compound contains a brand-new, superfine, natural abrasive (exclusive with HONITE) which assures a smooth finish on every die casting. And HONITE "Micro Cut" Compound can cut the "extra steps" from your barrel finishing operation, too. You can eliminate extra rinsing . . . extra coloring . . . extra labor!

HERE'S HOW! On zinc or aluminum die castings, HONITE "Micro Cut" Compound gently and quickly polishes out surface imperfections without "skinning" or exposing porosity—*and* reduces impingement or nicking, because it holds the parts firmly in the chip mass during the run. You get a quality surface for quality plating on zinc die castings . . . a super smooth surface on aluminum die castings . . . with no need for extra rinsing or coloring!

Write today for a demonstration in your plant of HONITE "Micro Cut" Compound.

Honite BRAND

MINNESOTA MINING & MFG. CO.
DEPT. FF-95, ST. PAUL 6, MINN.

☐ Yes, I'd like a demonstration of HONITE "Micro Cut" Compound.

☐ Send me free copy of booklet: "Facts and Figures Report on HONITE Barrel Finishing", which contains complete information about HONITE barrel finishing compounds.

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Company.....

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Made in U.S.A. by Minnesota Mining and Mfg. Co. General Offices: St. Paul 6, Minn. In Canada: P.O. Box 757, London, Ontario. Export Sales Office: 99 Park Avenue, New York City. Makers of "SCOTCH" Brand Pressure-Sensitive Tapes, "SCOTCH" Brand Magnetic Tape, "3M" Adhesives, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing.

AES News

Bruce Warner is liaison representative to the NAMF. He is associated with the New England Plating Co., Worcester, Mass.

George W. Cavanaugh of the General Electric Company, Syracuse, New York, is chairman of the Law Committee.

Dr. W. R. Meyer and W. L. Pinner are the AES representatives to the International Council for Electrodeposition.

Warner

Cavanaugh

Meyer

Pinner

The only filter on the market you can LEARN TO OPERATE IN ONE MINUTE!
CLEAN COMPLETELY IN LESS THAN 15 MINUTES!

Sel-Rex

DOUBLE DUTY FILTERS

Cuts filter cleaning time to less than 15 minutes

No filter on the market can be completely cleaned and reassembled as fast as a Sel-Rex DOUBLE DUTY Filter.

The entire Annular element is secured to the tank cover—lifts out freely and easily for cleaning, either by hand or with the sturdy, hand-operated davit mounted on the tank of larger units. Messy handling of wet and dirty elements is eliminated—you can even clean an element used for carbon treatment without soiling your hands!

Other outstanding advantages:

Completely new Sel-Rex-designed mechanical seal pump sharply reduces maintenance. Pump seal replacement method has been simplified.

The compact design saves valuable shop space . . . the new Annular element gives DOUBLE the amount of filtration area and speed in the same space required by other filters. All Sel-Rex DOUBLE DUTY Filters can be used with either the new Annular element or porous stone—no additional parts are required for conversion.

Standard models from 250-18,000 GPH capacity.

Larger models built to specification.

So simple to operate — You can learn to perform ALL filtering operations in less than ONE minute—precoat . . . filtering . . . backwashing . . . or liquid transfer — even if you've never operated a filter before. Simplified, easy-to-read instructions are fastened to the front of the tank — can be read when operating valves are used. Valves are conveniently located, colored and numbered for quick identification.

WRITE TODAY FOR ADDITIONAL INFORMATION OR QUOTATION

Sel-Rex

BART-MESSING CORPORATION

229 Main Street, Belleville 9, New Jersey

EDITORIAL BOARD MEETING A LIVELY SESSION

The Editorial Board held its meeting in Cleveland in the Statler Hotel on June 20. In attendance were: **P. P. Kovatis, R. D. Miller, E. R. Bowerman, A. Brenner, L. Diveley, F. Fulforth, W. C. Geissman, H. J. McAleer, C. W. Ostrander, H. Wiesner, A. Doria,** as well as the new members of the Board: **R. Harr, J. Capuano, A. Logozzo, P. Coady,** and **F. L. Scott.**

The meeting got off to a slam-bang start with a discussion of policy. Geissman presented a report on this which paced the fast-moving discussion.

Abner Brenner submitted that he had 15 papers and three research reports in hand already for the Washington Convention. Peter Kovatis pointed out that we should not allow the field to narrow. To this Diveley added that the charter of the Society defines us as "Metal Finishers" and that we should fulfill the whole scope. Logozzo proposed the theme, "Progress in the Finishing of Metals" which was seconded by Weisner and passed. F. L. Scott was then asked by the chairman to help in the field of organics.

Dr. S. Heiman had this to report on article reference department in PLATING: beginning with the August issue, this department will be compiled by **William Tucker** of the Rochester branch. In time, Tucker expects to include English journals and probably foreign-language magazines. Dr. Heiman then went on to speak of the Specifications Department which is still in the planning stage.

Many suggestions and much discussion went on on the duties of the Editorial Board members, duties of the Reviewers and the possibility of running review papers in PLATING and a program for a "what's new in the industry session" at some future time.

William Tucker was suggested as a nominee to fill out the one-year unexpired appointment of **D. Gray.**

The next meeting is scheduled for September 16, 1955 at the Hotel Statler, Washington, D. C.

Chairman P. P. Kovatis thanked the outgoing members of the Editorial Board for their distributions to the Society. They included, E. Bowerman, C. Ostrander, W. Geissman and **J. Winters.**

WANTED—Chemist or Metallurgist to work at the National Bureau of Standards in Washington, D. C. as a Research Associate of the American Electroplaters' Society. Post-graduate work or research experience required and background in physics or physical chemistry is desired.

Reply to Mr. Fielding Ogburn, National Bureau of Standards, Washington 25, D. C.

AES News

RESEARCH COMMITTEE MEETING

On June 22 at 2:30 P.M. in the Hotel Statler in Cleveland, Ohio (during the 42nd AES Convention and the 4th Industrial Finishing Exposition) the Research Committee met in a long and fruitful session.

Dr. R. M. Wick, who is the AES representative to NACE (ISCC), reported on the activity of the Corrosion Research Council and suggested the possibility that the AES sponsor basic research in corrosion.

The Oil Spreading Rates Project (No. 12) at Columbia University, was voted to be continued on a motion by **W. Meyer,** seconded by **L. Gilbert.**

The committee voted that an increase in pay of National Bureau of Standards personnel engaged in AES research would be at the discretion of the chairman of the Research Committee.

AES RESEARCH COMMITTEE

Past President **C. Nixon** reported that the present director of Project No. 14 was leaving and that a replacement was being sought.

R. Racine reported that there were 313 Sustaining Members as of June 1 as compared to 318 a year before. **Ed Bowerman** suggested that the material used in the Exposition Research Booth be offered to speakers and added that it be sent to National Headquarters and be made available to speakers as they need it.

P. Kovatis reported that the new Sustaining Membership plaque had been sent to Sustaining Members. (See pic elsewhere in this section). Kovatis was instructed, on Chairman **Borchert's** suggestion, to submit to the ASTM a request that **C. Sample** continue as representative from ASTM B-8 to the Research Committee.

Dr. Earl Serfass presented the 1955–56 Research Plan. The proposal calls for a balanced budget with and expenditure of $40,000. The plan was approved, after the committee extended its thanks to Dr. Serfass, and recommended that it be submitted to the Executive Board for final approval.

On the Task Committee on Reflectance Measurements and Surface Characterizations, E. Bowerman said that a geometric approach was apparently not fruitful, but that he had yet to receive a final report from the University of Rochester in connection with this proposal. He did pass around a panel showing acceptable surfaces with haze and polishing marks.

Many other matters discussed, of course, but after more than three hours of session Chairman Borchert adjourned the meeting. The next meeting of the committee is scheduled for Friday, September 23, 1955 at National Headquarters in Newark.

Present at this meeting were: Chairman **Borchert, E. Parker, R. Racine, M. Diggin, W. Blum, C. Sample, E. Bowerman, L. Gilbert, R. Ehrhardt, A. Wrisberg, W. Meyer, E. Serfass, G. Best, A. Du Rose, Peter Kovatis;** guests: Executive Board members, **R. Schaefer, F. Eddy, C. Kelly;** by invitation: **F. Ogburn** of the National Bureau of Standards, **Dr. E. J. Smith** of Michigan State College, **T. Basile** of the Los Angeles branch and Past President **C. Nixon.**

WILLIAM M. TUCKER TO EDITORIAL BOARD

Upon the resignation of Dan Gray of Oneida, Ltd., William Tucker of Eastman Kodak was named to fill the one-year unexpired term.

Dan Gray contributed immeasurably to the success of the Editorial Board during his two-year tenure and it was with some reluctance that his resignation was accepted. However, the big problem was to find as capable a man to complete his term. William Tucker is that man.

Tucker

Tucker has been active in the AES since 1937 and has made lasting contributions to its work. His papers on plating are still referred to and at least one may yet become a classic. He was Vice-Chairman in charge of Projects 4 and 7 (1947). In 1948 he served as Chairman of the Research Directing Subcommittee and in 1949-1950 he served as Chairman of the main Committee. He holds the Award of Merit. He is presently Chairman of the Project Committee, Project No. 14.

Tucker is also a member of the Electrochemical Society, the American Chemical Society and the American Society of Metals.

ERRATA

In referring to their participation in the Production Engineering Show to be held in Philadelphia, September 6–16, Oakite Products' release erroneously stated that their exhibit would occupy Space No. 562.

This should have read *Space No. 652.*

On page 870 of the July issue, there appeared a write-up of Lea Lectromag which read ". . . a precision instrument for measuring thickness of non-metallic coatings such as zinc . . . etc."

That word should have read *non-magnetic.*

RESEARCH PUBLICATIONS

Available From AES

Project No. 1
Reprints Serial No. 4
Stripping of copper from Various Base Metals, Parts I and II
F. C. Mathers, C. E. Landweerlen & E. L. Martin
Price $0.35

Project No. 13
Reprints Serial No. 13
Effect of Impurities and Purification of Electroplating Solutions
D. T. Ewing, R. Rominski & W. King
Price $0.40

Project No. 2
Reprints Serial No. 16
Determination of Impurities in Electroplating Solutions, Parts XV–XIX
E. J. Serfass & Co-workers
Price $1.00

Project No. 12
Reprints Serial No. 26
Cleaning and Preparation of Metals for Electroplating, IV, V, VI & VII
H. B. Linford & E. B. Saubestre
Price $3.50

Project No. 7
Reprints Serial No. 27
Methods for testing thickness of Electrodeposits, II & III
H. J. Read & F. R. Lorenz
Prize $1.35

Project No. 6
Reprints Serial No. 28
Porosity of Electrodeposited metals
N. Thon, D. G. Kelemen, L. Yang, S. Yang, D. Dean
Price $0.85

Address Your Order With Check or Money Order To:

AMERICAN ELECTROPLATERS' SOCIETY

445 Broad St. Newark, N. J.

Branch News

MELBOURNE

Midsummer Night's Meeting Down Under

President **P. Tikotin** opened the meeting with 65 members and visitors present, on June 16.

Two new members were elected, **C. Goebels** and **C. Meaker.** All business was then suspended to enable the three guest speakers—**W. J. Wynn,** cost accountant; **F. R. Quinton** and **J. Harris,** practical job platers—to give their talk on "Costing in Electroplating," after which the meeting was open for general discussion. After a long and lively discussion Walker proposed a vote of thanks to the speakers and congratulated them on a most enjoyable and informative evening.

MILWAUKEE

A Lively May Session

The Friday, May 6 meeting was called to order with 45 members and guests present. The main order of business was election of officers to be installed at the June meeting.

Two applicants were accepted as new members: **John Monday** and **Wayne Timple**

The Milwaukee branch annual meeting was a great success and the President thanked everyone who contributed to making it a success.

H. Bornitzke announced that the new membership directory would be ready for distribution soon.

Assistant Librarian **J. Severson** introduced **Ralph Petit** of Chicago Thrift Etching Co. speaker for the evening. Petit gave a very informative speech on the printing on anodic surfaces. A vast number of sample panels were shown to typify each phase of the printing and etching of nameplates.

After a lengthy question period the meeting was adjourned and refreshments were provided by the Diversey Corp.

New Officers

The June 3 meeting was called to order by President **G. Schwemer** with approximately 55 members present. The secretary's report was accepted and **L. Diveley** installed the following as the Branch's new officers: President—**H. Tessman,** 1st Vice-President—**R. Goodsell,** 2nd Vice-President—**G. Einberger,** Secretary-Treasurer—**C. Peter,** Librarian—**J. Severson,** Board of Managers—**F. Anderson.** The past president was commended for the fine job he did for the year.

Three applicants were accepted as new members: **Joseph Ashmead II, Kenneth Hess, Clarence Winters.**

The Secretary read all current correspondence from other branches and also cautioned all members about paying their dues.

Librarian **A. Linn** introduced a panel of branch members as speakers for the evening. The speakers and their subjects were: **L. Diveley**—"Choice of Organic Finishes," **V. Mattacotti**—"Choice of Plated Finishes and Specifications," **P. Ritzenthaler**—"Engineering Aspects of Plated Coatings," **C. Peter**—"Choice of Finishes for the Light Metals."

The panel drew a lively question period after which the meeting was adjourned. Those present retired to a buffet luncheon and beer provided for by the branch.

C. PETER
Secretary-Treasurer

NO ANODE SLUDGE

with NEW Anaconda "PLUS-4" ANODES*

(PHOSPHORIZED COPPER)

WHY PLATING COSTS LESS!

+1 no sludge

+2 no copper "build-up" in solution

+3 smoother, denser cathode deposits

+4 up to 15% *more* cathode deposits

CORRODED ANODES

Phosphorized Copper | Fire Refined Copper | Electrolytic "Tough Pitch" Copper

"Plus-4" Anode, far left, shows even, uniform corrosion. Irregular corrosion shown by other two anodes results in high scrap loss.

*For use under Patent No. 2,689,216

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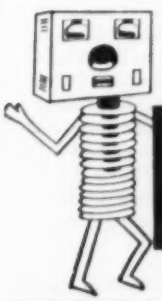

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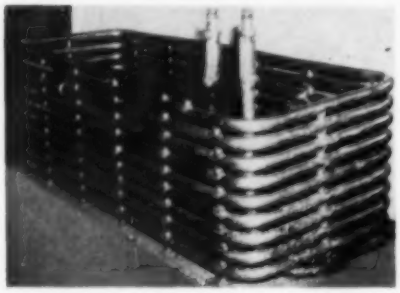

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Branch News

NEWARK

In A Brewery

The Newark branch assembled at the Ballantine Brewery forty strong for the last meeting of the year. After a visit through the very fine establishment—beer and sandwiches were served while **Don Foulke** presented just as nontechnical a paper on Nickel Plating as one would expect of a speaker using a bar as a rostrum.

During the brief business meeting **Thomas Wulff, Fremont L. Scott** and **Robert Fowler** were elected members of the branch. **Charles T. Smith** transferred to Waterbury branch and **Lewis M. Brown** reinstated.

D. Gardner Foulke
Secretary

WICHITA

Peterson Talks on Waste Disposal

At our meeting of May 25 we had **Howard Peterson** of Wallace & Tiernan as speaker.

Howard Peterson presented a well informed talk on cyanide and chromium waste disposal problems concerning both large and small plants. He discussed hexavalent chrome reduction with copperas, sodium bisulphide, and sulfur dioxide. Also, the use of chlorine in oxidizing cyanide waste. Peterson explained the process of a number of existing plants in our vicinity using Wallace & Tiernan equipment to control cyanide and chromium waste.

The only business transaction was that a motion was made and seconded to approve the payment of $1.07 for a rubber stamp and $2.00 for postcards.

F. B. Swift,
Secretary

WANTED—Chemist or Metallurgist to work at the National Bureau of Standards in Washington, D. C. as a Research Associate of the American Electroplaters' Society. Post-graduate work or research experience required and background in physics or physical chemistry is desired.

Reply to Mr. Fielding Ogburn, National Bureau of Standards, Washington 25, D. C.

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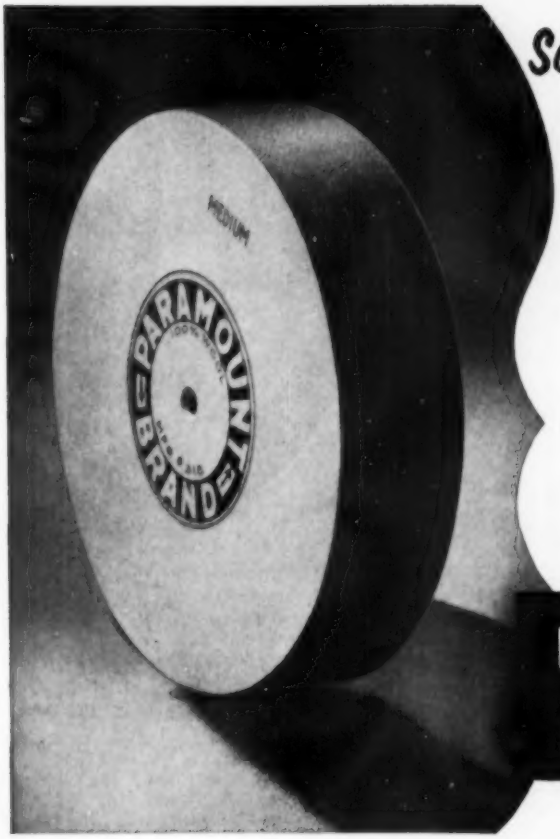

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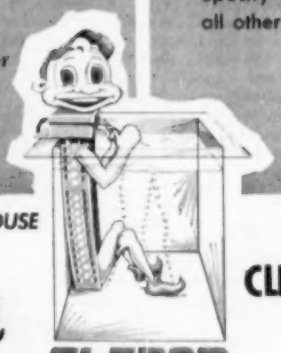

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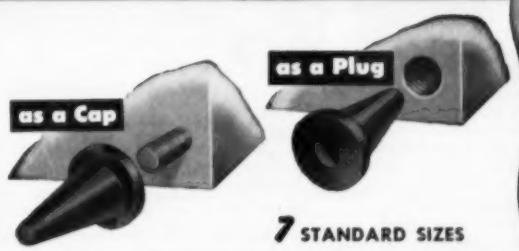

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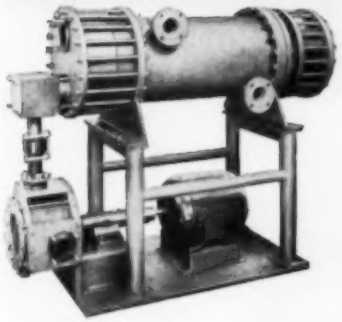

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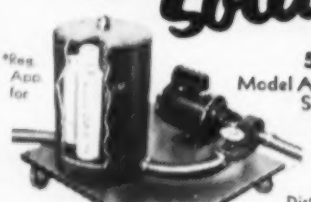

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September 12-16—Instrument Society of America, 10th Annual Instrument Conference and Exhibit, Shrine Exposition Hall and Auditorium, Los Angeles, Calif.

September 14-16—Porcelain Enamel Institute, 17th Annual Shop Practice Forum, Ohio State University, Columbus, Ohio.

September 19-22—American Institute of Mining and Metallurgical Engineers, Industrial Minerals Division, Asheville, N. C.

September 25-28—American Institute of Chemical Engineering, Regional Meeting, Lake Placid Club, Lake Placid, N. Y.

AES

September 16—Plating Editorial Board, Hotel Statler, Washington, D. C.

September 23—AES Research Committee, AES Headquarters, 445 Broad St., Newark, N. J.

June 17-21, 1956—43rd Annual Convention of the American Electroplaters' Society, Hotel Statler, Washington, D. C.

June 17-20, 1957—44th Annual Convention of the American Electroplaters' Society, Sheridan-Mt. Royal Hotel, Montreal, Canada

May 19-22, 1958—45th Annual Convention of the American Electroplaters' Society, Sheraton-Gibson Hotel, Cincinnati, Ohio.

June 14-18, 1959—46th Annual Convention of the American Electroplaters' Society and 5th Industrial Finishing Exposition, Detroit, Michigan; and 5th International Conference on Electrodeposition.

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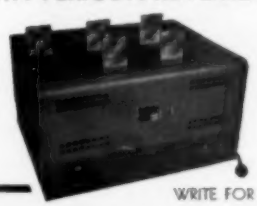

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